

NASA Technical Memorandum 80075

PERFORMANCE ESTIMATION FOR A HIGHLY LOADED
EIGHT-BLADE PROPELLER COMBINED WITH AN
ADVANCED TECHNOLOGY TURBOSHAFT ENGINE

SHELBY J. MORRIS, JR.

APRIL 1979



National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia 23665

PERFORMANCE ESTIMATION FOR A HIGHLY
LOADED EIGHT-BLADE PROPELLER COMBINED WITH
AN ADVANCED TECHNOLOGY TURBOSHAFT ENGINE

Shelby J. Morris, Jr.
Langley Research Center

SUMMARY

Performance estimation, weights, and scaling laws for an eight-blade highly loaded propeller combined with an advanced turboshaft engine are presented. The data are useful for planned aircraft mission studies using the turboprop propulsion system. Comparisons are made between the performance of the 1990+ technology turboprop propulsion system and the performance of both a current technology turbofan and an 1990+ technology turbofan.

INTRODUCTION

Recent predicted improvements in the propulsive efficiency of highly loaded propellers at cruise Mach numbers of 0.8 have led to increased interest (ref. 1) in the use of these devices to propel advanced aircraft. Early studies indicate that, compared to a high bypass turbofan, turbine-propeller systems offer a potential reduction of 15 to 30 percent in fuel consumption, a reduction in direct operating cost of approximately 10 percent, and a reduction in aircraft gross weight of approximately 20 percent for long endurance missions. The recent increased emphasis on reduction in fuel consumption created by decreasing supplies and increasing cost of fuel make this concept very timely. While near field noise, passenger comfort, and maintenance remain as potential problems, the possible benefits of this concept have lead to system studies of possible future propeller powered aircraft. These system studies require that the weight, scaling, and performance of the concept be known.

The purpose of this report is document the predicted performance, scaling, and weight of an eight-blade highly-loaded propeller (propfan) combined with an advanced turboshaft engine (the Pratt and Whitney STS 487 of reference 2), and to compare these results directly with an advanced high-bypass ratio turbofan. The approach used herein combines predicted propeller data with the engine characteristics to yield the uninstalled performance of the propeller-engine combination in terms identical to those by which turbofan performance characteristics are generally presented.

Few large commercial propeller-driven aircraft have been designed in the last two decades; thus, computer programs equivalent to those for jet aircraft often do not exist for sizing and predicting the performance of turboprop aircraft. The present paper provides a means of converting propeller and engine data to a common basis with turbofan engines. The converted data may be used directly in available programs, thus eliminating the need for developing new computer software.

SYMBOLS

C_p	propeller power coefficient, $(P/D^2)/\rho(ND)^3$
C_T	propeller thrust coefficient, $T/(\rho(ND)^2 D^2)$
D	propeller diameter, m (ft)
g	gravitational constant, $1.0(32.2 \text{ ft/s}^2)$
GR	gearbox gear ratio
HV	fuel lower heat value; $42.717 \times 10^6 \text{ J/kg (18,400 Btu/lbm)}$
J	propeller advance ratio, (V/ND)
JC	conversion factor; $1.0(778 \text{ ft lbf/Btu})$
K_1	constant in equation (10); 0.6325 (0.0935)
K_2	constant in equation (11); 1.0203×10^{-2} (5.115×10^{-3})
K_3	constant in equation (12); 6.3483×10^{-2} (0.1044)
M	mass, kg (lbf)
N	propeller revolutions per unit time, revolutions/s
P	engine shaft power, kw (hp)
T	net uninstalled thrust, N (lbf)
TSFC	thrust specific fuel consumption, $(\text{kg/hr})/N$ ((lbf/hr)/lbf)
V	velocity, m/s (ft/s)
W	weight, N (lbf)

w_f fuel flow, kg/s (lbm/s)

ρ density, kg/m³ (slugs/ft³)

η efficiency

Subscripts:

G/B gearbox

jet jet exhaust

net net uninstalled

NOM nominal

o free stream

ov overall

p propulsive

prop propeller

t thrust

tip propeller tip

RESULTS AND DISCUSSION

The Pratt and Whitney STS 487 turboshaft data (ref. 2) was matched with eight-blade propfan data (ref. 3) to calculate the uninstalled net thrust, fuel flow, thrust specific fuel consumption, and overall efficiency of the combined propulsion system. These parameters, and other associated engine and propeller parameters, are obtained as functions of Mach number, altitude, and power setting for both standard day and nonstandard day atmospheres. The propeller is first sized at a selected operating condition. The sizing data required are the design values of Mach number, altitude, shaft horsepower, residual jet thrust, propeller tip speed, power coefficient, and delta temperature above a standard day.

First, the free stream velocity and density are obtained for the known Mach number, altitude and ambient temperature, then the propeller diameter can be obtained as

$$D = \left[\frac{P}{C_p \rho (ND)^3} \right]^{1/2} \quad (1)$$

where

$$ND = V_{tip}/3.1416 \quad (2)$$

The advance ratio (J) is

$$J = V/ND \quad (3)$$

The thrust coefficient C_T can be obtained from the tables of reference 3 as a function of Mach number, advance ratio, and power coefficient. Finally, the propeller thrust can be computed from the thrust coefficient and the results of equations (1) and (2) as

$$T_{prop} = C_T \rho (ND)^2 D^2 \quad (4)$$

The net thrust can be calculated by adding the residual jet thrust, which is obtained from the engine specifications, to the net propeller thrust

$$T_{net} = T_{prop} + T_{jet} \quad (5)$$

The fuel flow is known from the engine data of reference 2, and when combined with the results of equation (5), the equivalent thrust specific fuel consumption is calculated as

$$TSFC = W_f/T_{net} \quad (6)$$

Finally, the efficiencies are obtained from their definitions (ref. 4) as

$$\eta_{ov} = \frac{T_{net} V_0}{W_f J C_H V + V_0^2/2g} \quad (7)$$

$$\eta_p = \frac{C_T J}{C_p} \quad (8)$$

For the off-design cases, the propeller diameter is fixed from the design computation and the power coefficient is computed from the known engine shaft power, the propeller diameter, the specified propeller rotational tip speed, and equation (2),

$$C_p = \frac{P/D^2}{\rho(ND)^3} \quad (9)$$

Then, the advance ratio J is computed from equation (3) using the velocity corresponding to the specified Mach number, altitude, and temperature. Using these values of C_p and J , and the tables of reference 3, the off-design thrust coefficient C_T can be computed. Equations (4) to (8) are then used to compute the remaining off-design parameters.

The propeller, gearbox, and turboshaft engine weights are estimated using the methods of reference 3 for the propeller and gearbox and reference 2 for the turboshaft engine. Curve fits of the methods described in these references result in the following approximate expressions:

$$WT_{prop} = K_1 D^{2.48808} v_{tip}^{0.30} (P/D^2)^{0.2925} \quad (10)$$

$$WT_{GB} = K_2 \left[\frac{GR}{8} \right]^{1/2} \left[\frac{P}{D^2} \right] D^3 \quad (11)$$

$$WT_{ENG} = K_3 (P/D^2) D^2 \quad (12)$$

The total uninstalled weight is the sum of equations (10), (11), and (12). It is recommended in reference 3 that this uninstalled weight be multiplied by 1.3 to account for installation. The nominal engine and propeller sizes can be scaled using the equations of references (2) and (3) (Appendix A). It is recommended that the engine scale factor be limited to the range between 0.7 and 1.45. In equation (10, (11), and (12), the power loading (P/D^2) has been expressed separately because, for a given design Mach number and altitude, the power loading (or power coefficient) is held constant as the engine size is scaled to match the required mission thrust. Furthermore, at the design Mach

number and altitude, and a constant specified tip speed, a constant power loading (P/D^2) uniquely fixes the advance ratio, the power coefficient, the thrust coefficient, the propulsive efficiency, the overall efficiency, and the thrust specific fuel consumption as the engine is scaled.

Sample Calculation

This procedure will now be illustrated by some numerical results which assumes that the eight-bladed propeller of reference 3 is matched to the turboshaft engine of reference 2. The tip speed is to be held constant at 244 m/s (800 ft/s). The propeller is to be sized for a Mach number of 0.8 at 11 km (36,089 ft). The propeller power coefficient at the design point is selected to be 1.692 with P/D^2 of 281 kw/m^2 (35 hp/ft^2). The propeller propulsive efficiency is 0.817 at the design conditions. The resulting design-size information is summarized in Table 1. Typical sea-level-static performance is also shown in Table I. The resulting propeller diameter for the baseline size of 15,238 kw (20,438 hp) at sea-level-static maximum-power condition was 4.519 m (14.825 ft). Note that the data from Table I indicates that the propeller was not able to absorb all the power available at sea level static conditions because of propeller stall. This phenomena is also shown in figure 1 which presents the thrust specific fuel consumption versus the uninstalled net thrust for the nominally sized propfan propulsion system. The total weight of the uninstalled engine, gearbox, and propeller using the nominal 15,238 kw (20,438 hp) engine size is estimated at 2653 kg (5851 lbm). The propeller tip speed of 244 m/s (800 ft/s) results in a propeller which has 1,030 revolutions per minute and a gearbox gear ratio of approximately 8.25.

Figure 1 summarizes the performance of the nominally sized propfan propulsion system. This figure presents the uninstalled thrust specific fuel consumption versus uninstalled net thrust for several different Mach numbers and altitude combinations.

A comparison of the turboprop (propfan) performance and the performance of the Pratt and Whitney JT9D-25 turbofan (ref. 5) is shown in figure 2. The turboprop has been scaled to match the maximum thrust of the JT9D-25 at Mach number 0.8 and 9.144 km (30,000 ft.). The JT9D-25 engine represents 1965 to 1970 technology while the turboprop gas generator represents 1990+ technology. Data for the 1990+ technology Pratt and Whitney STF-477 turbofan (ref. 6) has also been scaled to the same conditions and is shown in figure 2 to provide a more valid comparison of systems at the identical level of technology. It can be seen from figure 2 that the turboprop propulsion system reduces the cruise thrust specific fuel consumption at a Mach number of 0.8, 30,000 feet by about 27 percent when compared with the 1965 to 70 technology JT9D-25, and by about 22 percent compared with the 1990+ technology STF-477 turbofan.

A comparison of selected engine performance parameters for each of these scaled propulsion concepts are shown in Table II. Estimated weight scaling laws for the turboprop (propfan) engine concept are shown in figure 3. Note that the

turboprop weights increase more rapidly with size increase than does a typical turbofan which are also shown on this figure. This difference would impose an increased penalty on the turboprop as it was scaled upward and would tend to drive aircraft configurations towards a large number of small engine rather than a small number of large engines. The same conclusion may be reached by considering how the weights for the propeller and gearbox scale using equations (10) and (11), respectively. Of course, cost, complexity and availability would also be considerations in any choice of propulsion systems.

A summary of the performance data for the eight-blade turboprop (propfan) combined with an advanced turboshaft engine is presented as Appendix B.

CONCLUDING REMARKS

Performance estimations, weights, and scaling laws for an eight-blade high-loaded propeller combined with an advanced turboshaft engine have been presented. The data is useful for planned aircraft mission studies using this propulsion system. Comparisons are made between the performance and weight of the 1990+ technology turboprop propulsion system and the performance and weight of a current technology turbofan and a 1990+ technology turbofan.

At Mach numbers of 0.8 and 9,144 meter altitude, the 1990+ technology turboprop produced thrust specific fuel consumption values about 27 percent less than the current technology turbofan and about 22 percent less than the 1990+ advanced technology turbofan. These benefits must be measured against the increased system weight, potential increased maintenance problems, and noise and passenger acceptance considerations before any conclusions can be made.

This report proports to furnish the necessary propulsion data to enable evaluation of air transportation systems using these turboprop propulsion system. The data is presented in a format compatible with existing mission programs.

REFERENCES

1. Dugan, J. F.; Gatzen, B. S.; and Adamson, W. M: Propfan Propulsion - Its Status and Potential SAE Paper Number 780995, November 27-30, 1978.
2. Kropp, W. J.: Preliminary Performance and Installation Data for the STS-487 Turboshaft Engine. Pratt and Whitney Aircraft Report CDS-11 East Hartford, CN (Some of the data in the report is Proprietary.).
3. Baum, J. A. et al: Propfan Data Support Study Technical Report. NASA CR-152141, Hamilton Standard Division of United Technologies Corporation, Windsor Locks, CN, February 28, 1978.
4. Shepard, D. G.: Aerospace Propulsion, American Elsevier Publishing Company, Inc., New York, NY 1972.
5. USAF Propulsion Characteristics Summary, Volume 1 - Airbreathing. Aeronautical Systems Division, Air Force Systems, Command Wright Patterson Air Force Base, OH June 1972. (Some items in this report are classified Confidential.).
6. Perkins, G. M.: Preliminary Performance and Installation Data for the STF 477 Turboshaft Engine. Pratt and Whitney Aircraft Report CDS-6, East Hartford, CN (Some of the data in this report is Proprietary.).

Appendix A

SCALING LAWS FOR TURBOPROP ENGINE

Engine:

Nominal Engine Length = 2.240 m (7.350 ft)
 Nominal Engine Maximum Diameter = 0.914 m (3 ft)
 Nominal Engine RPM = 8500
 Nominal Engine Takeoff Power = P_{NOM} = 15.23 Mw (20424 hp)

Configuration:

Two spool gas generator with free turbine and third coaxial shaft technology level 1990+ (in service)

Scaling:

$$D_{eng} = \left[\frac{P_{Takeoff}}{P_{NOM}} \right]^{0.5} D_{eng,NOM}$$

$$Length_{eng} = \left[\frac{P_{Takeoff}}{P_{NOM}} \right]^{0.43} Length_{eng,NOM}$$

Propeller

$$D = D_{NOM} \left[\frac{P_{Takeoff}}{P_{NOM}} \right]^{1/2}$$

Free turbine RPM

$$RPM = RPM_{NOM} \left[\frac{P_{NOM}}{P_{Takeoff}} \right]^{0.5}$$

Appendix B
TYPICAL PROPFAN PERFORMANCE OUTPUT
Eight-Blade Propeller

SIZE POINT

Mach Number	=	0.80
Altitude	=	11 km (36089 ft)
Delta Temperature	=	10°F
J	=	3.081
C _p	=	1.692
C _T	=	0.4485
n _p	=	0.8167

DEFINITIONS FOR COMPUTER OUTPUT

XM	Mach number
ALT	altitude (feet)
DELT	delta temperature above standard day ($^{\circ}$ F)
SHP	engine shaft horsepower (hp)
T	propeller net thrust (lbf)
T + FRES	propeller + residual jet net thrust (lbf)
ETAP	propulsive efficiency $(C_T J / C_p)$
C_p	propeller power coefficient
C_T	propeller thrust coefficient
J	propeller advance ratio
WFT	engine fuel flow (lbm/hr)

TYPICAL PROPFAN PERFORMANCE OUTPUT

NOTE: ERROR MESSAGE "ERROR CP OUT OF RANGE OF TABLE" indicates that the engine is producing more power at the considered power setting than the propeller can absorb.

X#	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
ERROR, CP OUT OF RANGE OF TABLE										
0.00	0.0	0.0	20438.1	0.0	1955.0	0.0000	1.3042	0.0000	0.0000	6258.08
0.00	0.0	0.0	18001.4	0.0	1665.6	0.0000	1.1487	0.0000	0.0000	5556.48
0.00	0.0	0.0	15694.7	16335.3	17752.3	0.0000	1.0015	.4819	0.000	4899.55
0.00	0.0	0.0	13421.4	18760.0	19961.9	0.0000	.8565	.5540	0.000	4277.88
0.00	0.0	0.0	11303.5	18777.4	19750.1	0.0000	.7213	.5539	0.000	3713.18
0.00	0.0	0.0	9364.9	18275.0	19067.6	0.0000	.5976	.5391	0.000	3201.46
0.00	0.0	0.0	7545.0	17122.9	17752.4	0.0000	.4815	.5051	0.000	2725.72
0.00	0.0	0.0	5907.5	15452.0	15941.9	0.0000	.3770	.4558	0.000	2294.92
0.00	0.0	0.0	4540.2	13502.7	13888.8	0.0000	.2897	.3983	0.000	1923.00
0.00	0.0	0.0	3442.1	11498.7	11792.1	0.0000	.2197	.3392	0.000	1610.87
•10	0.0	0.0	20547.6	24432.3	26157.0	•2410	1.3112	•7208	•438	6280.25
•10	0.0	0.0	18062.7	23402.6	24849.4	•2626	1.1526	.6904	•438	5568.06
•10	0.0	0.0	15798.3	22371.7	23589.7	•2870	1.0081	.6600	•438	4919.77
•10	0.0	0.0	13480.6	21028.5	22019.1	•3162	.8602	.6204	•438	4288.04
•10	0.0	0.0	11350.5	19659.0	20458.8	•3510	.7243	.5800	•438	3721.41
•10	0.0	0.0	9420.9	18045.0	18681.2	•3882	.6012	.5323	•438	3213.26
•10	0.0	0.0	7580.1	15973.6	16460.3	•4271	.4837	.4712	•438	2731.81
•10	0.0	0.0	5939.5	13668.7	14030.9	•4664	.3790	.4032	•438	2300.64
•10	0.0	0.0	4568.8	11352.8	11625.4	•5036	.2915	.3349	•438	1928.33
•10	0.0	0.0	3466.1	9194.5	9387.5	•5377	.2212	.2712	•438	1615.43
•20	0.0	0.0	20666.2	22221.7	23739.4	•4317	1.3315	.6556	•877	6344.78
•20	0.0	0.0	18268.2	21258.2	22500.0	•4717	1.1658	.6271	•877	5606.16
•20	0.0	0.0	15963.8	20082.7	21104.6	•5100	1.0187	.5925	•877	4948.09
•20	0.0	0.0	13643.9	18550.6	19365.2	•5512	.8707	.5473	•877	4317.13

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•20	0.	0.0	11504.6	16799.0	17431.6	•5919	•7341	•4956	•877	3748.02
•20	0.	0.0	9534.2	14872.1	15352.3	•6323	•6084	•4387	•877	3230.59
•20	0.	0.0	7702.6	12771.5	13116.2	•6721	•4915	•3768	•877	2752.28
•20	0.	0.0	6030.6	10565.4	10804.6	•7102	•3848	•3117	•877	2316.58
•20	0.	0.0	4663.5	8522.6	8676.1	•7408	•2976	•2514	•877	1945.43
•20	0.	0.0	3539.4	6659.4	6754.3	•7627	•2259	•1965	•877	1629.42
•30	0.	0.0	21362.6	20363.9	21663.4	•5796	•1.3632	•6007	•1.315	6442.07
•30	0.	0.0	18676.9	19010.8	20059.1	•6189	•1.1918	•5608	•1.315	5682.76
•30	0.	0.0	16316.0	17589.8	18425.2	•6555	•1.0412	•5189	•1.315	5008.37
•30	0.	0.0	13927.4	15898.0	16533.7	•6941	•8888	•4690	•1.315	4366.21
•30	0.	0.0	11752.4	14127.5	14598.7	•7309	•7500	•4168	•1.315	3791.15
•30	0.	0.0	9737.1	12164.0	12495.8	•7596	•6214	•3588	•1.315	3264.89
•30	0.	0.0	7879.9	10192.5	10398.8	•7865	•5028	•3007	•1.315	2783.35
•30	0.	0.0	6183.9	8261.3	8377.9	•8123	•3946	•2437	•1.315	2342.95
•30	0.	0.0	4798.6	6483.5	6531.9	•8216	•3062	•1913	•1.315	1969.94
•30	0.	0.0	3662.4	4996.7	4992.0	•8296	•2337	•1474	•1.315	1652.43
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
ERROR, CP	OUT OF RANGE OF TABLE									
0.00	5000.	0.0	17849.7	0.0	1741.4	0.0000	1.3219	0.0000	0.000	5465.86
ERROR, CP	OUT OF RANGE OF TABLE									
0.00	5000.	0.0	16420.6	0.0	1573.7	0.0000	1.2160	0.0000	0.000	5009.87
ERROR, CP	OUT OF RANGE OF TABLE									
0.00	5000.	0.0	14267.2	0.0	1324.5	0.0000	1.0566	0.0000	0.000	4404.92
0.00	5000.	0.0	12381.3	15744.8	16867.5	0.0000	•9169	•5390	•0.000	3876.79
0.00	5000.	0.0	10450.2	16238.1	17161.6	0.0000	•7739	•5559	•0.000	3365.56
0.00	5000.	0.0	8741.0	15968.7	16722.6	0.0000	•6473	•5467	•0.000	2913.86

XM	ALT	DELT	SHP	T	T+FRES	TAP	CP	CT	J	WFT
0.00	5000.	0.0	7106.8	15198.2	15800.7	0.0000	.5263	.5203	0.000	2489.58
0.00	5000.	0.0	5595.6	13931.6	14406.2	0.0000	.4144	.4770	0.000	2098.93
0.00	5000.	0.0	4297.0	12236.4	12601.0	0.0000	.3182	.4189	0.000	1751.99
0.00	5000.	0.0	3250.1	10453.2	10738.6	0.0000	.2407	.3579	0.000	1462.47
•10	5000.	0.0	17969.4	21205.1	22751.6	•2350	1.3307	•7260	•431	5490.01
•10	5000.	0.0	16497.0	20597.2	21981.3	•2487	1.2217	•7052	•431	5024.61
•10	5000.	0.0	14332.2	19683.9	20829.4	•2735	1.0614	•6739	•431	4416.51
•10	5000.	0.0	12434.7	18643.7	19598.8	•2986	•9209	•6383	•431	3886.35
•10	5000.	0.0	10495.6	17465.1	18237.8	•3314	•7773	•5979	•431	3374.83
•10	5000.	0.0	8761.9	16144.3	16762.0	•3670	•6489	•5527	•431	2917.62
•10	5000.	0.0	7135.7	14511.7	14988.8	•4050	•5284	•4968	•431	2494.57
•10	5000.	0.0	5622.9	12556.3	12917.8	•4448	•4164	•4299	•431	2103.68
•10	5000.	0.0	4314.3	10483.0	10760.9	•4840	•3195	•3589	•431	1756.49
•10	5000.	0.0	3272.3	8544.5	8740.5	.5201	.2423	.2925	•431	1466.56
•20	5000.	0.0	18310.6	19295.3	20681.4	•4198	1.3560	•6606	•862	5562.23
•20	5000.	0.0	16727.1	18794.8	20004.7	•4476	1.2367	•6434	•862	5069.73
•20	5000.	0.0	14527.5	17799.3	18778.5	•4881	1.0758	•6094	•862	4451.34
•20	5000.	0.0	12589.0	16631.0	17428.3	•5262	•9323	•5694	•862	3914.07
•20	5000.	0.0	10631.1	15178.5	15805.0	•5687	•7673	•5196	•862	3398.62
•20	5000.	0.0	8894.0	13640.4	14122.7	•6109	•6586	•4670	•862	2941.88
•20	5000.	0.0	7232.6	11847.7	12203.3	•6525	•5356	•4056	•862	2511.34
•20	5000.	0.0	5706.1	9882.5	10134.0	•6899	•4226	•3383	•862	2118.23
•20	5000.	0.0	4395.6	7987.9	8154.9	•7239	•3255	•2735	•862	1769.83
•20	5000.	0.0	3338.7	6309.4	6418.9	.7528	.2472	.2160	•862	1479.04
•30	5000.	0.0	18909.7	17874.4	19114.0	.5648	1.4004	.6119	1.292	5688.80

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•30	5000.	0.0	17092.4	17014.0	18052.6	•5948	1.2658	•5825	1.292	5138.53
•30	5000.	0.0	14854.5	15763.0	16564.3	•6341	1.1001	•5397	1.292	4510.46
•30	5000.	0.0	12842.0	14470.4	15117.9	•6733	•9510	•4954	1.292	3960.18
•30	5000.	0.0	10859.2	12905.9	13390.2	•7101	•8042	•4418	1.292	3438.69
•30	5000.	0.0	9076.5	11280.2	11632.1	•7426	•6722	•3862	1.292	2972.35
•30	5000.	0.0	7393.4	9585.1	9821.7	•7746	•5475	•3282	1.202	2538.86
•30	5000.	0.0	5848.9	7812.2	7951.9	•7981	•4331	•2675	1.292	2142.26
•30	5000.	0.0	4520.7	6176.7	6248.1	•8164	•3348	•2115	1.292	1792.34
•30	5000.	0.0	3450.3	4770.7	4792.7	•8262	•2555	•1633	1.292	1499.58
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
ERROR, CP OUT OF RANGE OF TABLE										
0.00	10000.	0.0	15256.5	0.0	1506.1	0.0000	1.3181	0.0000	0.0000	4688.87
ERROR, CP OUT OF RANGE OF TABLE										
0.00	10000.	0.0	14363.6	0.0	1409.6	0.0000	1.2410	0.0000	0.0000	4374.86
ERROR, CP OUT OF RANGE OF TABLE										
0.00	10000.	0.0	12995.7	0.0	1252.5	0.0000	1.1228	0.0000	0.0000	3963.64
0.00	10000.	0.0	11210.3	12981.8	14026.3	0.0000	•9686	•5185	0.0000	3466.14
0.00	10000.	0.0	9621.8	13921.7	14798.8	0.0000	•8313	•5561	0.0000	3041.47
0.00	10000.	0.0	8034.9	13840.1	14556.1	0.0000	•6942	•5528	0.0000	2626.27
0.00	10000.	0.0	6591.9	13319.8	13898.5	0.0000	•5695	•5320	0.0000	2252.42
0.00	10000.	0.0	5250.0	12362.1	12821.6	0.0000	•4536	•4938	0.0000	1908.67
0.00	10000.	0.0	4040.9	11019.1	11371.4	0.0000	•3491	•4401	0.0000	1590.65
0.00	10000.	0.0	3048.2	9463.1	9733.1	0.0000	•2634	•3780	0.0000	1321.16
•10	10000.	0.0	15363.0	18196.7	19543.4	•2317	1.3273	•7268	•423	4711.71
•10	10000.	0.0	14459.0	17822.6	19074.2	•2411	1.2492	•7119	•423	4394.90
•10	10000.	0.0	13062.9	17237.1	18331.1	•2581	1.1286	•6885	•423	3976.77

XW	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•10	10000.	0.0	11263.6	16357.4	17258.0	•2841	•9732	•6533	•423	3476.40
•10	10000.	0.0	9664.8	15410.7	16151.6	•3119	•8350	•6155	•423	3049.06
•10	10000.	0.0	8072.6	14337.4	14930.8	•3474	•6975	•5727	•423	2633.02
•10	10000.	0.0	6622.3	13057.4	13524.6	•3857	•5722	•5215	•423	2257.77
•10	10000.	0.0	5264.4	11445.9	11802.1	•4253	•4548	•4572	•423	1909.68
•10	10000.	0.0	4061.9	9659.3	9923.1	•4651	•3509	•3858	•423	1594.19
•10	10000.	0.0	3071.2	7903.8	8093.8	•5034	•2653	•3157	•423	1325.70
•20	10000.	0.0	15687.1	16578.5	17795.1	•4134	•3554	•6622	•846	4783.29
•20	10000.	0.0	14739.3	16297.9	17411.2	•4326	•2735	•6510	•846	4453.73
•20	10000.	0.0	13240.6	15704.0	16651.5	•4640	•1440	•6272	•846	4009.76
•20	10000.	0.0	11420.5	14748.8	15515.1	•5052	•9867	•5891	•846	3505.67
•20	10000.	0.0	9772.1	13634.2	14249.8	•5458	•8443	•5446	•846	3068.49
•20	10000.	0.0	8183.7	12296.9	12773.6	•5878	•7071	•4912	•846	2652.89
•20	10000.	0.0	6709.9	10789.7	11149.2	•6290	•5797	•4310	•846	2272.08
•20	10000.	0.0	5342.5	9139.9	9398.2	•6693	•4616	•3651	•846	1923.06
•20	10000.	0.0	4127.7	7459.8	7637.9	•7070	•3566	•2980	•846	1606.04
•20	10000.	0.0	3128.2	5931.6	6046.5	•7418	•2703	•2369	•846	1336.21
•30	10000.	0.0	16233.1	15421.8	16520.7	•5575	•4025	•6160	•269	4899.55
•30	10000.	0.0	15188.9	14938.3	15926.1	•5771	•3123	•5967	•269	4545.53
•30	10000.	0.0	13466.4	14052.7	14856.9	•6123	•1635	•5613	•269	4048.19
•30	10000.	0.0	11689.1	12961.3	13602.0	•6506	•0099	•5177	•269	3556.59
•30	10000.	0.0	9977.8	11706.8	12198.3	•6885	•8621	•4676	•269	3104.77
•30	10000.	0.0	8382.5	10376.2	10735.5	•7264	•7242	•4144	•269	2688.58
•30	10000.	0.0	6864.8	8862.4	9118.6	•7575	•5931	•3540	•269	2299.64
•30	10000.	0.0	5471.5	7314.5	7478.7	•7844	•4727	•2922	•269	1945.68
•30	10000.	0.0	4245.4	5859.9	5947.9	•8099	•3668	•2341	•269	1626.66

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
• 30	10000.	0.0	3224.2	4509.2	4550.5	• 8207	• 2786	.1801	1.269	1353.76
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
ERROR, CP OUT OF RANGE OF TABLE	0.00	15000.	0.0	12880.6	0.0	1294.1	0.0000	1.3058	0.0000	0.0000 3983.22
ERROR, CP OUT OF RANGE OF TABLE	0.00	15000.	0.0	12211.5	0.0	1219.1	0.0000	1.2380	0.0000	0.0000 3736.53
ERROR, CP OUT OF RANGE OF TABLE	0.00	15000.	0.0	11421.8	0.0	1129.0	0.0000	1.1579	0.0000	0.0000 3468.73
ERROR, CP OUT OF RANGE OF TABLE	0.00	15000.	0.0	10116.5	0.0	975.7	0.0000	1.0256	0.0000	0.0000 3090.80
ERROR, CP OUT OF RANGE OF TABLE	0.00	15000.	0.0	8705.2	11688.0	12505.6	0.0000	.8825	.5478	0.0000 2713.35
ERROR, CP OUT OF RANGE OF TABLE	0.00	15000.	0.0	7337.9	11840.0	12515.1	0.0000	.7439	.5549	0.0000 2355.21
ERROR, CP OUT OF RANGE OF TABLE	0.00	15000.	0.0	6039.0	11550.9	12095.5	0.0000	.6122	.5413	0.0000 2019.48
ERROR, CP OUT OF RANGE OF TABLE	0.00	15000.	0.0	4840.0	10858.2	11291.6	0.0000	.4907	.5089	0.0000 1713.88
ERROR, CP OUT OF RANGE OF TABLE	0.00	15000.	0.0	3766.9	9785.5	10120.5	0.0000	.3819	.4586	0.0000 1435.60
ERROR, CP OUT OF RANGE OF TABLE	0.00	15000.	0.0	2839.3	8470.4	8724.8	0.0000	.2878	.3970	0.0000 1188.85
• 10	15000.	0.0	12971.5	15490.0	16652.2	• 2292	1.3150	• 7260	• 415	4002.18
• 10	15000.	0.0	12298.6	15210.9	16299.9	• 2374	1.2468	• 7129	• 415	3754.95
• 10	15000.	0.0	11490.2	14872.0	15872.3	• 2485	1.1649	• 6970	• 415	3482.12
• 10	15000.	0.0	10156.5	14284.0	15134.0	• 2700	1.0296	• 6694	• 415	3098.16
• 10	15000.	0.0	8747.5	13468.9	14170.6	• 2956	.8868	• 6312	• 415	2721.21
• 10	15000.	0.0	7364.4	12621.4	13189.9	• 3290	.7466	• 5915	• 415	2359.45
• 10	15000.	0.0	6069.2	11585.7	12033.8	• 3664	.6153	• 5430	• 415	2025.09
• 10	15000.	0.0	4870.3	10284.7	10629.1	• 4054	.4937	• 4820	• 415	1719.40
• 10	15000.	0.0	3785.9	8786.8	9044.0	• 4455	.3838	• 4118	• 415	1438.85
• 10	15000.	0.0	2855.7	7218.0	7404.8	• 4852	.2895	• 3383	• 415	1191.95

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•20	15000.	0.0	13251.1	14131.3	15187.0	•4094	1.3434	•6623	•830	4065.08
•20	15000.	0.0	12560.2	13929.6	14908.4	•4258	1.2733	•6528	•830	3810.75
•20	15000.	0.0	11701.2	13639.7	14525.8	•4475	1.1862	•6392	•830	3525.02
•20	15000.	0.0	10268.4	12942.8	13675.9	•4839	1.0410	•6066	•830	3118.76
•20	15000.	0.0	8873.9	12062.3	12655.9	•5219	•8996	•5653	•830	2744.93
•20	15000.	0.0	7461.6	10965.1	11430.9	•5642	•7564	•5139	•830	2376.80
•20	15000.	0.0	6157.5	9741.3	10096.8	•6074	•6242	•4565	•830	2040.85
•20	15000.	0.0	4938.1	8365.1	8627.2	•6503	•5006	•3920	•830	1731.45
•20	15000.	0.0	3843.1	6913.7	7098.4	•6907	•3696	•3240	•830	1449.49
•20	15000.	0.0	2906.5	5494.0	5614.6	•7257	•2947	•2575	•830	1201.22
•30	15000.	0.0	13724.0	13180.2	14145.2	•5530	1.3913	•6177	1.246	4168.82
•30	15000.	0.0	12995.9	12836.7	13720.9	•5688	1.3175	•6016	1.246	3902.82
•30	15000.	0.0	12037.7	12357.9	13139.8	•5912	1.2204	•5792	1.246	3593.14
•30	15000.	0.0	10474.4	11451.1	12074.1	•6296	1.0619	•5367	1.246	3157.52
•30	15000.	0.0	9074.4	10532.0	11022.1	•6684	•9199	•4936	1.246	2781.64
•30	15000.	0.0	7625.0	9356.0	9724.8	•7668	•7730	•4386	1.246	2405.90
•30	15000.	0.0	6308.2	8099.9	8362.3	•7394	•6395	•3796	1.246	2067.07
•30	15000.	0.0	5057.9	6774.6	6954.5	•7713	•5128	•3175	1.246	1752.53
•30	15000.	0.0	3948.4	5480.1	5586.3	•7993	•4003	•2568	1.246	1467.74
•30	15000.	0.0	2991.7	4228.1	4284.1	•8139	•3033	•1982	1.246	1216.71
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
ERROR, CP OUT OF RANGE OF TABLE	0.00	0.	25.0	20224.0	0.0	1900.3	0.0000	1.3528	0.0000	0.000 6277.24
ERROR, CP OUT OF RANGE OF TABLE	0.00	0.	25.0	17719.6	0.0	1605.5	0.0000	1.1853	0.0000	0.000 5554.93
ERROR, CP OUT OF RANGE OF TABLE	0.00	0.	25.0	15523.8	0.0	1375.1	0.0000	1.0384	0.0000	0.000 4923.94

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
0.00	0.	25.0	13289.2	17664.9	18813.2	0.0000	.8889	.5462	0.000	4294.43
0.00	0.	25.0	11265.1	17956.0	18907.8	0.0000	.7535	.5553	0.000	3739.21
0.00	0.	25.0	9394.5	17586.3	18360.0	0.0000	.6284	.5438	0.000	3237.00
0.00	0.	25.0	7619.2	16680.7	17300.6	0.0000	.5096	.5158	0.000	2764.96
0.00	0.	25.0	6011.9	15200.5	15687.5	C.0000	.4021	.4700	0.000	2337.62
•10	0.	25.0	20325.0	23541.6	25211.9	•2404	1.3595	•7280	•449	6297.51
•10	0.	25.0	17796.2	22501.0	23892.6	•2624	1.1904	•6958	•449	5569.95
•10	0.	25.0	15601.6	21575.7	22749.7	•2870	1.0436	•6672	•449	4939.59
•10	0.	25.0	13345.4	20306.1	21267.6	•3157	•8927	•6279	•449	4304.19
•10	0.	25.0	11314.4	19038.0	19815.5	•3492	•7568	•5887	•449	3747.84
•10	0.	25.0	9415.5	17518.6	18143.8	•3861	•6298	•5417	•449	3239.99
•10	0.	25.0	7653.1	15654.7	16133.5	•4245	•5119	•4841	•449	2770.76
•10	0.	25.0	6043.2	13506.3	13867.1	•4638	•4042	•4176	•449	2343.16
•20	0.	25.0	20595.7	21333.5	22792.9	•4299	1.3776	•6597	•898	6351.49
•20	0.	25.0	18036.1	20456.5	21648.4	•4707	1.2064	•6326	•898	5616.04
•20	0.	25.0	15798.6	19348.4	20332.7	•5083	1.0568	•5983	•898	4975.20
•20	0.	25.0	13520.8	17912.4	18695.2	•5498	•9044	•5539	•898	4334.68
•20	0.	25.0	11460.7	16300.3	16915.2	•5903	•7666	•5040	•898	3773.67
•20	0.	25.0	9542.9	14523.2	14990.8	•6316	•6383	•4491	•898	3261.64
•20	0.	25.0	7782.6	12604.2	12940.3	•6721	•5206	•3898	•898	2793.16
•20	0.	25.0	6138.7	10476.7	10714.2	•7083	•4106	•3240	•898	2359.98
•30	0.	25.0	21004.4	19544.5	20799.9	•5793	1.4050	•6044	1.347	6430.47
•30	0.	25.0	18433.5	18327.9	19331.5	•6190	1.2330	•5667	1.347	5691.90
•30	0.	25.0	16126.0	16953.8	17753.5	•6545	1.0787	•5243	1.347	5034.34

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.30	0.	25.0	13821.3	15403.7	16012.8	.6938	.9245	.4763	1.347	4386.41
.30	0.	25.0	11704.0	13720.7	14174.9	.7298	.7829	.4243	1.347	3816.09
.30	0.	25.0	9748.6	11874.2	12193.8	.7583	.6521	.3672	1.347	3296.36
.30	0.	25.0	7949.7	10043.5	10249.9	.7865	.5318	.3106	1.347	2821.81
.30	0.	25.0	6312.1	8199.6	8305.9	.8087	.4222	.2536	1.347	2389.30
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.30	5000.	25.0	18736.2	17194.1	18396.5	.56118	1.4568	.6180	1.324	5710.77
.30	5000.	25.0	16705.7	16272.8	17253.9	.5964	1.2989	.5849	1.324	5108.34
.30	5000.	25.0	14635.2	15161.2	15947.4	.6343	1.1379	.5450	1.324	4517.86
.30	5000.	25.0	12664.8	13937.2	14551.1	.6738	.9847	.5010	1.324	3959.99
.30	5000.	25.0	10746.9	12455.4	12920.4	.7096	.8356	.4477	1.324	3444.05
.30	5000.	25.0	9015.4	10945.9	11284.4	.7433	.7010	.3934	1.324	2983.67
.30	5000.	25.0	7402.8	9359.5	9587.3	.7741	.5756	.3364	1.324	2560.26
.30	5000.	25.0	5901.6	7681.7	7817.4	.7969	.4589	.2761	1.324	2169.25
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.30	10000.	25.0	16156.2	14839.4	15912.0	.5527	1.4681	.6234	1.302	4933.27
.30	10000.	25.0	14983.7	14344.2	15290.8	.5761	1.3616	.6026	1.302	4546.16
.30	10000.	25.0	13126.6	13409.1	14168.5	.6147	1.1928	.5633	1.302	4017.47
.30	10000.	25.0	11488.6	12426.1	13033.1	.6509	1.0440	.5220	1.302	3540.23
.30	10000.	25.0	9793.6	11234.8	11699.9	.6903	.8899	.4720	1.302	3088.74
.30	10000.	25.0	8250.1	9977.8	10322.9	.7278	.7497	.4192	1.302	2680.40
.30	10000.	25.0	6820.2	8581.9	8623.2	.7572	.6198	.3605	1.302	2306.31
.30	10000.	25.0	5469.0	7136.9	7292.3	.7853	.4970	.2998	1.302	1956.92
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.30	15000.	25.0	13664.3	12656.1	13597.3	.5475	1.4597	.6250	1.279	4197.61

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.30	15000.	25.0	12915.2	12357.9	13214.5	.5656	1.3797	.6103	1.279	3923.56
.30	15000.	25.0	11795.1	11811.7	12552.2	.5920	1.2600	.5833	1.279	3575.77
.30	15000.	25.0	10242.4	10941.1	11525.5	.6315	1.0942	.5403	1.279	3139.86
.30	15000.	25.0	8859.8	10052.4	10512.3	.6707	.9465	.4964	1.279	2754.73
.30	15000.	25.0	7451.8	8935.6	9279.7	.7088	.7961	.4413	1.279	2385.39
.30	15000.	25.0	6189.7	7769.0	8019.9	.7420	.6612	.3837	1.279	2055.96
.30	15000.	25.0	5005.1	6554.3	6721.8	.7741	.5347	.3237	1.279	1750.42
.30	0.	0.0	20971.2	20174.3	21457.8	.5849	1.3382	.5952	1.315	6332.15
.30	0.	0.0	18354.8	18829.2	19843.3	.6238	1.1713	.5555	1.315	5588.89
.30	0.	0.0	15970.1	17376.1	18178.6	.6616	1.0191	.5126	1.315	4912.43
.30	0.	0.0	13611.4	15645.3	16255.0	.6989	.6686	.4615	1.315	4282.37
.30	0.	0.0	11456.0	13858.9	14307.9	.7356	.7310	.4088	1.315	3713.27
.30	0.	0.0	9473.1	11903.7	12212.8	.7641	.6045	.3512	1.315	3195.62
.30	0.	0.0	7602.1	9876.2	10074.6	.7899	.4851	.2914	1.315	2712.95
.30	0.	0.0	5969.1	8008.0	8111.1	.8157	.3809	.2362	1.315	2285.73
.30	0.	0.0	4630.7	6264.4	6297.4	.8226	.2955	.1848	1.315	1922.54
.30	0.	0.0	3512.9	4788.0	4777.6	.8288	.2242	.1412	1.315	1609.62
.40	0.	0.0	21541.3	18226.3	19306.9	.6660	1.3746	.5377	1.754	6438.06
.40	0.	0.0	18892.2	16808.7	17640.7	.7213	1.2056	.4959	1.754	5688.33
.40	0.	0.0	16422.7	15342.0	15965.1	.7574	1.0480	.4526	1.754	4991.12
.40	0.	0.0	14027.9	13796.7	14240.9	.7974	.8952	.4070	1.754	4356.25
.40	0.	0.0	11802.5	11897.3	12184.6	.8173	.7532	.3510	1.754	3773.39
.40	0.	0.0	9737.6	9877.9	10042.5	.8224	.6214	.2914	1.754	3238.84
.40	0.	0.0	7844.2	8061.3	8123.7	.8332	.5006	.2378	1.754	2753.32
.40	0.	0.0	6184.4	6456.2	6436.2	.8464	.3946	.1905	1.754	2322.49

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•40	0.	0.0	4818.4	4983.7	4914.6	•6386	•3075	•1470	1.754	1956.39
•40	0.	0.0	3683.0	3715.7	3605.4	•8179	.2350	.1096	1.754	1641.01
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•40	5000.	0.0	19441.1	16272.0	17341.5	•6668	1.4397	•5571	1.723	5769.47
•40	5000.	0.0	17162.4	15096.9	15937.9	•7008	1.2710	.5168	1.723	5119.24
•40	5000.	0.0	15033.1	13893.5	14539.1	•7363	1.1133	.4756	1.723	4514.02
•40	5000.	0.0	12903.6	12516.8	12987.5	•7728	•9556	.4285	1.723	3943.92
•40	5000.	0.0	10915.5	11067.6	11391.9	•8078	•8083	.3789	1.723	3424.15
•40	5000.	0.0	9082.2	9300.7	9510.5	•8158	•6726	.3184	1.723	2951.08
•40	5000.	0.0	7377.8	7663.9	7769.2	•8276	•5464	.2624	1.723	2515.59
•40	5000.	0.0	5838.7	6157.3	6176.7	•8402	•4324	.2108	1.723	2122.07
•40	5000.	0.0	4527.0	4798.2	4766.2	•8444	•3352	.1643	1.723	1777.95
•40	5000.	0.0	3468.0	3600.5	3528.0	•8271	•2568	.1233	1.723	1489.56
•50	5000.	0.0	20258.1	14988.8	15923.8	•7368	1.5002	•5131	2.154	5935.05
•50	5000.	0.0	17793.1	13684.5	14365.2	•7659	1.3177	.4685	2.154	5235.47
•50	5000.	0.0	15591.0	12365.3	12860.4	•7898	1.1546	.4233	2.154	4612.86
•50	5000.	0.0	13358.9	10890.1	11213.1	•8118	•9893	.3728	2.154	4022.93
•50	5000.	0.0	11321.7	9430.9	9617.9	•8295	•8384	.3229	2.154	3494.90
•50	5000.	0.0	9433.9	7982.7	8053.5	•8427	•6986	.2733	2.154	3009.44
•50	5000.	0.0	7671.0	6563.5	6543.2	•8521	•5681	.2247	2.154	2563.96
•50	5000.	0.0	6085.3	5213.5	5123.5	•8532	•4506	.1785	2.154	2163.26
•50	5000.	0.0	4769.7	4026.2	3882.3	•8406	•3532	.1378	2.154	1819.92
•50	5000.	0.0	3666.6	3006.3	2842.5	•8165	.2715	.1029	2.154	1524.70
ERROR, CP	OUT OF RANGE OF TABLE	5000.	0.0	2753.1	0.0	-182.9	0.0000	.2039	0.0000	2.154 1269.57
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•40	10000.	0.0	16843.4	14137.2	15128.7	•6567	1.4553	.5647	1.692	5011.72

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•40	10000.	0.0	15531.1	13510.8	14358.3	•6806	1•3419	•5396	1•692	4592•79
•40	10000.	0.0	13544.2	12410.0	13061.5	•7169	1•1702	•4957	1•692	4035.50
•40	10000.	0.0	11797.2	11323.8	11818.7	•7510	1•0193	•4523	1•692	3554•70
•40	10000.	0.0	10016.2	10100.0	10449.2	•7889	•8654	•4034	1•692	3090•41
•40	10000.	0.0	8402.5	8657.4	8892.9	•8061	•7260	•3458	1•692	2672•97
•40	10000.	0.0	6869.2	7210.2	7348.7	•8212	•5935	•2880	1•692	2283•38
•40	10000.	0.0	5458.2	5815.4	5873.0	•8336	•4716	•2323	1•692	1927•38
•40	10000.	0.0	4240.6	4599.5	4593.1	•8486	•3664	•1837	1•692	1611•55
•40	10000.	0.0	3236.8	3449.8	3406.7	•8339	•2797	•1378	1•692	1344.49
•50	10000.	0.0	17795.1	13170.0	14078.3	•7238	1•5375	•5260	2•115	5214•70
•50	10000.	0.0	16110.0	12330.7	13054.4	•7485	1•3919	•4925	2•115	4705•34
•50	10000.	0.0	14069.2	11181.5	11706.6	•7772	1•2156	•4466	2•115	4130•56
•50	10000.	0.0	122231.5	10005.2	10370.2	•8000	1•0568	•3996	2•115	3632•97
•50	10000.	0.0	10385.3	8707.3	8937.8	•8200	•8973	•3478	2•115	3154•64
•50	10000.	0.0	8723.6	7454.8	7576.2	•8357	•7537	•2978	2•115	2727•80
•50	10000.	0.0	7134.8	6193.3	6225.2	•8489	•6164	•2474	2•115	2327•15
•50	10000.	0.0	5682.2	4954.6	4916.3	•8528	•4909	•1979	2•115	1964•59
•50	10000.	0.0	4437.7	3850.8	3758.7	•8486	•3834	•1538	2•115	1645•64
•50	10000.	0.0	3420.8	2894.8	2768.9	•8276	•2956	•1156	2•115	1377•20
•65	10000.	0.0	19344.2	12171.1	12942.1	•7999	1•6713	•4861	2•750	5531•92
•65	10000.	0.0	17064.3	10980.9	11506.6	•8181	1•4743	•4386	2•750	4879•86
•65	10000.	0.0	15051.6	9863.0	10203.5	•8331	1•3004	•3939	2•750	4305•82
•65	10000.	0.0	12996.7	8666.1	8844.8	•8477	1•1229	•3461	2•750	3763•21
•65	10000.	0.0	11091.8	7500.6	7549.0	•8597	•9583	•2996	2•750	3274•91
•65	10000.	0.0	9324.7	6355.0	6297.6	•8665	•8056	•2538	2•750	2826•19
•65	10000.	0.0	7639.0	5198.6	5065.0	•8652	•6600	•2076	2•750	2408.49

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•65	10000.	0.0	6128.2	4111.1	3915.8	•8529	•5295	•1642	2.750	2036.03
•65	10000.	0.0	4840.8	3148.8	2913.0	•8270	•4182	•1258	2.750	1712.84
•65	10000.	0.0	3767.2	2301.6	2051.3	•7768	•3255	•0919	2.750	1436.37
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•40	15000.	0.0	14286.8	12104.6	12983.0	•6506	1.4484	•5673	1.661	4274.71
•40	15000.	0.0	13477.9	11731.7	12521.4	•6683	1.3664	•5498	1.661	3988.34
•40	15000.	0.0	12243.5	11064.7	11721.6	•6939	1.2412	•5186	1.661	3613.03
•40	15000.	0.0	10598.6	10118.7	10616.7	•7331	1.0745	•4742	1.661	3162.80
•40	15000.	0.0	9134.0	9089.1	9460.0	•7641	•9260	•4260	1.661	2776.17
•40	15000.	0.0	7657.9	7919.6	8177.8	•7941	•7763	•3712	1.661	2396.12
•40	15000.	0.0	6310.9	6661.9	6829.8	•8105	•6398	•3122	1.661	2054.22
•40	15000.	0.0	5052.8	5439.8	5526.8	•8266	•5122	•2549	1.661	1737.97
•40	15000.	0.0	3937.2	4320.6	4344.8	•8426	•3991	•2025	1.661	1453.20
•40	15000.	0.0	2996.0	3271.7	3254.3	•8385	•3037	•1533	1.661	1207.05
•50	15000.	0.0	15146.6	11323.7	12144.6	•7175	1.5355	•5307	2.076	4461.49
•50	15000.	0.0	14208.4	10877.1	11588.2	•7347	1.4404	•5098	2.076	4138.47
•50	15000.	0.0	12654.3	10047.3	10598.9	•7621	1.2829	•4709	2.076	3688.48
•50	15000.	0.0	11016.1	9036.9	9433.4	•7873	1.1168	•4235	2.076	3239.58
•50	15000.	0.0	9457.1	7969.4	8238.9	•8088	•9587	•3735	2.076	2832.66
•50	15000.	0.0	7957.7	6859.3	7020.6	•8273	•8067	•3215	2.076	2448.48
•50	15000.	0.0	6560.3	5755.5	5830.8	•8420	•6651	•2697	2.076	2096.17
•50	15000.	0.0	5259.6	4667.1	4671.6	•8517	•5332	•2187	2.076	1772.98
•50	15000.	0.0	4110.5	3649.7	3600.5	•8522	•4167	•1711	2.076	1482.94
•50	15000.	0.0	3158.4	2752.3	2664.5	•8364	•3202	•1290	2.076	1236.28
XM	ALT	DELT	SHP	T	T+FRES	tETAP	CP	CT	J	WFT
•50	20000.	0.0	12697.0	9628.2	10358.1	•7137	1.5197	•5327	2.036	3769.11

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.50	20000.	0.0	12043.2	9312.9	9965.1	7278	1.4414	.5153	2.036	3528.53
.50	20000.	0.0	11197.5	8871.3	9422.2	7457	1.3402	.4909	2.036	3251.08
.50	20000.	0.0	9790.7	8044.8	8455.5	7734	1.1718	.4451	2.036	2860.58
.50	20000.	0.0	8506.6	7198.4	7493.4	7965	1.0181	.3983	2.036	2519.80
.50	20000.	0.0	7173.4	6231.8	6421.3	8177	.8586	.3448	2.036	2178.02
.50	20000.	0.0	5958.7	5285.0	5390.6	8348	.7132	.2924	2.036	1871.11
.50	20000.	0.0	4811.6	4336.6	4373.7	8483	.5759	.2400	2.036	1586.34
.50	20000.	0.0	3773.6	3413.3	3397.7	8514	.4517	.1889	2.036	1327.75
.50	20000.	0.0	2888.1	2587.0	2534.2	8431	.3457	.1431	2.036	1102.19
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.40	10000.	18.0	17512.7	14058.0	15112.3	6396	1.5695	.5824	1.724	5300.91
.40	10000.	18.0	16488.7	13646.3	14581.5	6595	1.4777	.5654	1.724	4937.50
.40	10000.	18.0	14813.9	12820.5	13584.5	6896	1.3276	.5312	1.724	4438.28
.40	10000.	18.0	12937.7	11788.1	12375.0	7260	1.1595	.4884	1.724	3910.95
.40	10000.	18.0	11211.4	10707.5	11144.4	7610	1.0047	.4436	1.724	3427.24
.40	10000.	18.0	9501.9	9569.3	9875.8	8025	.8515	.3965	1.724	2978.29
.40	10000.	18.0	7953.3	8116.7	8316.7	8132	.7128	.3363	1.724	2574.27
.40	10000.	18.0	6486.4	6713.5	6825.3	8247	.5813	.2781	1.724	2197.90
.40	10000.	18.0	5153.7	5409.1	5443.3	8363	.4619	.2241	1.724	1856.72
.40	10000.	18.0	3996.6	4253.5	4236.5	8480	.3582	.1762	1.724	1556.42
.50	10000.	18.0	18536.5	13181.1	14159.0	7083	1.6612	.5461	2.155	5524.96
.50	10000.	18.0	17283.6	12634.4	13468.9	7281	1.5489	.5234	2.155	5102.67
.50	10000.	18.0	15300.7	11633.2	12260.6	7573	1.3712	.4820	2.155	4527.75
.50	10000.	18.0	13445.1	10573.2	11033.6	7833	1.2049	.4380	2.155	4002.30
.50	10000.	18.0	11602.6	9390.3	9702.8	8061	1.0398	.3890	2.155	3494.80
.50	10000.	18.0	9870.6	8165.0	8354.6	8239	.8846	.3383	2.155	3043.01

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.50	10000.	18.0	8255.0	6953.3	7044.1	•8390	7398	•2681	2.155	2625.63
.50	10000.	18.0	6759.6	5774.0	5780.4	•8508	•6058	•2392	2.155	2244.46
.50	10000.	18.0	5372.1	4600.2	4544.2	•8529	•4814	•1906	2.155	1894.07
.50	10000.	18.0	4190.2	3556.3	3461.2	•8453	•3755	•1473	2.155	1589.99
.65	10000.	18.0	20428.1	12446.4	13327.9	•7889	1.8307	•5157	2.801	5933.48
.65	10000.	18.0	18510.5	11504.0	12162.6	•8047	1.6589	•4766	2.801	5344.50
.65	10000.	18.0	16331.9	10368.4	10810.2	•8220	1.4636	•4296	2.801	4720.43
.65	10000.	18.0	14339.8	9265.7	9537.2	•8367	1.2851	•3839	2.801	4157.29
.65	10000.	18.0	12361.1	8119.0	8244.0	•8505	1.1078	•3364	2.801	3624.03
.65	10000.	18.0	10543.6	7012.5	7021.6	•8612	•9449	•2905	2.801	3155.82
.65	10000.	18.0	8838.0	5916.5	5833.1	•8668	•7921	•2451	2.801	2722.11
.65	10000.	18.0	7230.7	4817.8	4668.3	•8627	•6480	•1996	2.801	2319.69
.65	10000.	18.0	5812.5	3803.8	3595.1	•8474	•5209	•1576	2.801	1965.52
.65	10000.	18.0	4606.5	2914.5	2670.8	•8192	•4128	•1207	2.801	1659.33
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.50	5000.	18.0	21538.9	15221.4	16278.8	•7163	1.6524	•5398	2.193	6393.55
.50	5000.	18.0	19327.3	14216.6	15044.5	•7456	1.4627	•5042	2.193	5733.41
.50	5000.	18.0	17044.3	12981.9	13587.9	•7720	1.3076	•4604	2.193	5078.17
.50	5000.	18.0	14868.2	11665.6	12092.6	•7953	1.1406	•4137	2.193	4465.84
.50	5000.	18.0	12735.7	10251.7	10523.7	•8159	•9770	•3636	2.193	3887.74
.50	5000.	18.0	10790.6	8869.5	9015.0	•8331	•8278	•3146	2.193	3379.86
.50	5000.	18.0	8981.0	7484.9	7526.1	•8447	•6890	•2655	2.193	2912.05
.50	5000.	18.0	7292.3	6129.7	6093.2	•8520	•5594	•2174	2.193	2480.18
.50	5000.	18.0	5792.9	4873.4	4769.7	•8527	•4444	•1728	2.193	2096.74
.50	5000.	18.0	4530.7	3740.0	3604.8	•8367	•3476	•1326	2.193	1766.87
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.50	15000.	18.0	15678.2	11273.1	12148.4	•7033	1.6509	•5488	2.116	4703.55

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•50	15000.	18.0	14864.6	10923.3	11699.5	•7168	1.5653	•5317	2.116	4402.09
•50	15000.	18.0	13703.2	10377.3	11024.0	•7408	1.4430	•5052	2.116	4029.08
•50	15000.	18.0	11981.6	9437.9	9913.8	•7705	1.2617	•4594	2.116	3544.89
•50	15000.	18.0	10479.2	8502.2	8845.4	•7936	1.1035	•4139	2.116	3120.78
•50	15000.	18.0	8918.9	7429.5	7651.2	•8148	•9392	•3617	2.116	2714.13
•50	15000.	18.0	7511.4	6387.8	6513.2	•8318	•7910	•3110	2.116	2350.25
•50	15000.	18.0	6173.2	5338.2	5385.4	•8459	•6500	•2599	2.116	2009.99
•50	15000.	18.0	4936.4	4302.2	4287.1	•8525	•5198	•2094	2.116	1699.81
•50	15000.	18.0	3857.7	3357.3	3291.6	•8513	•4062	•1634	2.116	1424.93
 XM										
•50	20000.	18.0	13108.5	9553.6	10319.1	•6996	1.6321	•5499	2.077	3961.10
•50	20000.	18.0	12488.6	9287.4	9980.6	•7139	1.5549	•5346	2.077	3725.18
•50	20000.	18.0	11790.7	8969.4	9579.6	•7303	1.4680	•5163	2.077	3473.38
•50	20000.	18.0	10686.9	8387.6	8875.3	•7534	1.3306	•4828	2.077	3139.51
•50	20000.	18.0	9285.6	7554.7	7910.0	•7810	1.1561	•4348	2.077	2747.69
•50	20000.	18.0	7997.8	6697.7	6945.1	•8039	•9958	•3855	2.077	2406.49
•50	20000.	18.0	6731.9	5777.0	5928.6	•8238	•8382	•3325	2.077	2080.60
•50	20000.	18.0	5574.1	4873.3	4950.0	•8393	•6940	•2805	2.077	1785.34
•50	20000.	18.0	4479.6	3973.1	3990.4	•8514	•5577	•2287	2.077	1511.74
•50	20000.	18.0	3511.2	3119.1	3087.9	•8526	•4372	•1795	2.077	1268.62
 XM										
•65	15000.	0.0	16779.7	10665.0	11420.2	•7930	1.7011	•4998	2.699	4813.09
•65	15000.	0.0	15352.8	9934.3	10522.6	•8074	1.5564	•4656	2.699	4368.27
•65	15000.	0.0	13459.1	8897.2	9291.9	•8248	1.3645	•4170	2.699	3833.36
•65	15000.	0.0	11775.9	7924.6	8168.7	•8396	1.1938	•3714	2.699	3376.29
•65	15000.	0.0	10068.5	6888.1	7002.8	•8536	1.0207	•3228	2.699	2937.11

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.65	15000.	0.0	8515.8	5895.0	5909.5	.8637	.8633	.2763	2.699	2542.81
.65	15000.	0.0	7039.7	4898.0	4829.6	.8681	.7137	.2296	2.699	2175.17
.65	15000.	0.0	5654.1	3905.2	3778.5	.8618	.5732	.1830	2.699	1836.56
.65	15000.	0.0	4457.3	3003.8	2832.7	.8408	.4519	.1408	2.699	1540.48
.65	15000.	0.0	3468.1	2225.7	2030.5	.8007	.3516	.1043	2.699	1289.14
.75	15000.	0.0	17990.6	10131.5	10837.4	.8108	1.8239	.4748	3.114	5066.69
.75	15000.	0.0	16062.3	9198.0	9682.6	.8244	1.6284	.4311	3.114	4502.08
.75	15000.	0.0	14178.9	8240.5	8534.5	.8367	1.4374	.3862	3.114	3963.12
.75	15000.	0.0	12349.5	7269.9	7407.6	.8475	1.2520	.3407	3.114	3476.35
.75	15000.	0.0	10584.8	6292.5	6303.0	.8559	1.0731	.2949	3.114	3025.38
.75	15000.	0.0	8959.5	5345.6	5256.0	.8590	.9083	.2505	3.114	2615.81
.75	15000.	0.0	7407.8	4395.1	4228.1	.8542	.7510	.2060	3.114	2233.26
.75	15000.	0.0	5966.7	3474.3	3256.6	.8383	.6049	.1628	3.114	1884.65
.75	15000.	0.0	4742.7	2654.5	2399.4	.8058	.4808	.1244	3.114	1585.99
.75	15000.	0.0	3727.4	1960.7	1685.9	.7573	.3779	.0919	3.114	1331.90
.80	15000.	0.0	18580.3	9852.8	10517.2	.8143	1.8836	.4618	3.322	5184.05
.80	15000.	0.0	16448.1	8857.7	9286.6	.8270	1.6675	.4151	3.322	4572.54
.80	15000.	0.0	14567.9	7945.7	8189.3	.8376	1.4769	.3724	3.322	4032.07
.80	15000.	0.0	12663.3	6980.2	7061.1	.8465	1.2838	.3271	3.322	3529.13
.80	15000.	0.0	10874.5	6026.1	5980.6	.8510	1.1024	.2824	3.322	3073.19
.80	15000.	0.0	9195.1	5086.7	4943.1	.8495	.9322	.2384	3.322	2652.52
.80	15000.	0.0	7614.5	4167.9	3949.9	.8406	.7719	.1953	3.322	2265.70
.80	15000.	0.0	6163.5	3289.9	3021.2	.8197	.6248	.1542	3.322	1915.80
.80	15000.	0.0	4909.4	2513.2	2210.7	.7861	.4977	.1178	3.322	1612.48
ERROR, CP OUT OF RANGE OF TABLE										
.80	15000.	0.0	3872.9	0.0	-316.5	0.0000	.3926	0.0000	3.322	1355.22

XH	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.65	20000.	0.0	14146.6	9122.8	9813.1	.7891	1.6932	.5048	2.647	4097.71
.65	20000.	0.0	13340.4	8709.8	9300.9	.7989	1.5967	.4819	2.647	3803.48
.65	20000.	0.0	12030.4	8002.3	8442.7	.8139	1.4399	.4428	2.647	3411.52
.65	20000.	0.0	10487.3	7121.9	7413.4	.8310	1.2552	.3941	2.647	2990.42
.65	20000.	0.0	9073.3	6271.7	6442.6	.8458	1.0860	.3470	2.647	2620.32
.65	20000.	0.0	7678.4	5389.3	5458.7	.8588	.9190	.2982	2.647	2266.25
.65	20000.	0.0	6387.8	4525.2	4513.6	.8668	.7646	.2504	2.647	1943.07
.65	20000.	0.0	5175.5	36662.8	3589.2	.8660	.6195	.2027	2.647	1646.95
.65	20000.	0.0	4078.0	2837.8	2721.8	.8515	.4881	.1570	2.647	1378.93
.65	20000.	0.0	3163.1	2122.3	1975.6	.8210	.3786	.1174	2.647	1149.78
.75	20000.	0.0	15331.6	8753.5	9430.6	.8061	1.8350	.4843	3.054	4345.25
.75	20000.	0.0	14257.1	8235.0	8775.8	.8155	1.7064	.4557	3.054	3990.63
.75	20000.	0.0	12558.7	7385.2	7741.5	.8303	1.5031	.4086	3.054	3507.25
.75	20000.	0.0	11064.2	6600.5	6810.1	.8423	1.3243	.3652	3.054	3095.70
.75	20000.	0.0	9523.7	5754.4	5836.6	.8531	1.1399	.3184	3.054	2697.76
.75	20000.	0.0	8093.6	4926.9	4911.0	.8595	.9687	.2726	3.054	2336.37
.75	20000.	0.0	6742.8	4100.9	4007.5	.8587	.8070	.2269	3.054	2002.34
.75	20000.	0.0	5462.9	3285.9	3136.2	.8492	.6538	.1818	3.054	1692.65
.75	20000.	0.0	4329.3	2532.5	2343.9	.8259	.5182	.1401	3.054	1418.86
.75	20000.	0.0	3390.0	1874.8	1662.0	.7808	.4058	.1037	3.054	1187.39
.80	20000.	0.0	15979.0	8593.8	9269.1	.8099	1.9125	.4755	3.258	4486.57
.80	20000.	0.0	14655.1	7975.0	8464.0	.8195	1.7541	.4413	3.258	4070.20
.80	20000.	0.0	12901.5	7129.6	7449.7	.8322	1.5442	.3945	3.258	3571.39
.80	20000.	0.0	11363.7	6362.1	6529.3	.8431	1.3601	.3520	3.258	3149.33
.80	20000.	0.0	9772.5	5518.9	5556.3	.8505	1.1697	.3054	3.258	2739.95
.80	20000.	0.0	8317.2	4706.3	4646.2	.8522	.9955	.2604	3.258	2373.48

XM	ALT	DELT	SHP	T	T+FRS	ETAP	CP	CT	J	WFT
XM	ALT	DELT	SHP	T	T+FRS	ETAP	CP	CT	J	WFT
.80	20000.	0.0	6921.8	3901.5	3766.4	.8489	.8285	.2159	3.258	2030.31
.80	20000.	0.0	5628.4	3121.7	2930.1	.8353	.6737	.1727	3.258	1718.71
.80	20000.	0.0	4467.6	2384.2	2159.7	.8037	.5347	.1319	3.258	1440.69
ERROR, CP OUT DF RANGE OF TABLE										
.80	20000.	0.0	3516.0	0.0	-245.5	0.0000	.4208	0.0000	3.258	1208.13
.65	25000.	0.0	11749.0	7703.2	8320.1	.7861	1.6713	.5066	2.594	3425.73
.65	25000.	0.0	11170.6	7405.6	7948.6	.7949	1.5890	.4870	2.594	3211.32
.65	25000.	0.0	10456.7	7018.3	7473.7	.8048	1.4875	.4615	2.594	2970.97
.65	25000.	0.0	9258.5	6341.9	6666.6	.8213	1.3170	.4171	2.594	2629.93
.65	25000.	0.0	8051.9	5622.3	5831.3	.8372	1.1454	.3697	2.594	2310.26
.65	25000.	0.0	6852.8	4869.8	4981.3	.8521	.9748	.3202	2.594	2003.20
.65	25000.	0.0	5723.5	4121.0	4155.0	.8633	.8142	.2710	2.594	1720.52
.65	25000.	0.0	4664.2	3375.1	3348.8	.8676	.6635	.2220	2.594	1461.04
.65	25000.	0.0	3697.4	2653.0	2580.8	.8603	.5260	.1745	2.594	1225.32
.65	25000.	0.0	2853.9	1989.4	1886.8	.8358	.4060	.1308	2.594	1017.89
.75	25000.	0.0	12773.1	7417.0	8035.2	.6034	1.8170	.4878	2.993	3653.83
.75	25000.	0.0	12107.0	7093.6	7622.9	.6106	1.7222	.4665	2.993	3412.04
.75	25000.	0.0	11129.3	6613.9	7021.0	.8222	1.5832	.4349	2.993	3103.89
.75	25000.	0.0	9728.6	5882.0	6141.6	.8365	1.3839	.3868	2.993	2717.23
.75	25000.	0.0	8493.6	5203.8	5346.1	.8476	1.2082	.3422	2.993	2390.50
.75	25000.	0.0	7207.6	4465.1	4506.4	.8571	1.0253	.2936	2.993	2063.96
.75	25000.	0.0	6045.6	3761.2	3727.1	.8607	.8600	.2473	2.993	1775.00
.75	25000.	0.0	4934.7	3055.4	2963.6	.8566	.7020	.2009	2.993	1505.63
.75	25000.	0.0	3920.4	2379.4	2247.8	.8397	.5577	.1565	2.993	1261.74
.75	25000.	0.0	3050.9	1767.8	1608.4	.8017	.4340	.1163	2.993	1050.71

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•80	25000.	0.0	13343.0	7305.7	7932.9	•8080	1.8981	•4804	3.192	3782.21
•80	25000.	0.0	12612.8	6959.7	7483.2	•8143	1.7942	•4577	3.192	3519.65
•80	25000.	0.0	11422.5	6391.6	6771.2	•8258	1.6249	•4203	3.192	3159.78
•80	25000.	0.0	10009.2	5681.4	5911.5	•8376	1.4238	•3736	3.192	2770.02
•80	25000.	0.0	8709.3	4998.0	5108.1	•8469	1.2389	•3287	3.192	2428.91
•80	25000.	0.0	7420.2	4288.7	4296.5	•8529	1.0555	•2820	3.192	2101.54
•80	25000.	0.0	6212.0	3594.0	3525.9	•8538	•8837	•2363	3.192	1801.07
•80	25000.	0.0	5082.2	2908.9	2783.2	•8447	•7229	•1913	3.192	1529.27
•80	25000.	0.0	4053.8	2255.3	2088.6	•8210	•5767	•1483	3.192	1282.99
•80	25000.	0.0	3167.5	1673.6	1482.9	•7797	•4506	•1101	3.192	1069.93
•85	25000.	0.0	13951.0	7204.2	7842.1	•8097	1.9846	•4738	3.392	3918.83
•85	25000.	0.0	13100.2	6829.0	7348.2	•8174	1.8635	•4491	3.392	3624.00
•85	25000.	0.0	11698.0	6180.6	6527.2	•8284	1.6641	•4065	3.392	3210.33
•85	25000.	0.0	10304.2	5514.5	5713.9	•8391	1.4658	•3626	3.392	2824.68
•85	25000.	0.0	8942.0	4828.3	4901.6	•8466	1.2720	•3175	3.392	2468.61
•85	25000.	0.0	7627.7	4129.7	4101.8	•8489	1.0851	•2716	3.392	2136.21
•85	25000.	0.0	6401.5	3450.6	3345.6	•8452	•9106	•2269	3.392	1833.27
•85	25000.	0.0	5238.5	2778.7	2618.1	•8317	•7452	•1827	3.392	1553.91
•85	25000.	0.0	4184.2	2148.4	1950.5	•8051	•5952	•1413	3.392	1303.43
•85	25000.	0.0	3284.6	1609.5	1389.8	•7683	•4672	•1058	3.392	1088.70
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•65	30000.	0.0	9635.5	6437.5	6978.3	•7843	1.6409	•5068	2.539	2839.60
•65	30000.	0.0	9185.2	6201.4	6682.4	•7926	1.5642	•4882	2.539	2667.79
•65	30000.	0.0	8700.6	5935.4	6354.7	•8009	1.4817	•4673	2.539	2493.26
•65	30000.	0.0	8044.4	5567.5	5909.9	•8125	1.3699	•4383	2.539	2284.03
•65	30000.	0.0	6998.1	4947.9	5181.3	•8300	1.1917	•3895	2.539	2005.32

XW	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.65	30000.	0.0	6038.5	4349.2	4498.2	8455	1.0283	.3424	2.539	1755.67
.65	30000.	0.0	5046.1	3695.8	3765.9	8598	.8593	.2910	2.539	1505.82
.65	30000.	0.0	4142.1	3064.6	3074.5	8686	.7054	.2413	2.539	1282.67
.65	30000.	0.0	3301.6	2436.1	2400.1	8662	.5622	.1918	2.539	1077.80
.65	30000.	0.0	2546.6	1837.7	1769.1	8472	.4337	.1447	2.539	893.74
.75	30000.	0.0	10491.2	6207.8	6761.3	8015	1.7866	.4887	2.930	3035.97
.75	30000.	0.0	9998.2	5967.6	6447.5	8085	1.7026	.4698	2.930	2847.14
.75	30000.	0.0	9435.3	5691.0	6097.5	8170	1.6068	.4480	2.930	2648.98
.75	30000.	0.0	8527.3	5217.1	5517.6	8287	1.4521	.4107	2.930	2379.54
.75	30000.	0.0	7399.6	4602.1	4785.7	8425	1.2601	.3623	2.930	2080.16
.75	30000.	0.0	6358.3	4007.4	4096.6	8537	1.0828	.3155	2.930	1811.35
.75	30000.	0.0	5336.2	3394.1	3408.6	8616	.9087	.2672	2.930	1555.98
.75	30000.	0.0	4389.7	2792.3	2747.8	8616	.7475	.2198	2.930	1324.27
.75	30000.	0.0	3507.0	2200.2	2114.4	8498	.5972	.1732	2.930	1112.13
.75	30000.	0.0	2720.1	1650.4	1534.7	8219	.4632	.1299	2.930	923.17
.80	30000.	0.0	10970.6	6120.0	6684.7	8060	1.8682	.4818	3.125	3145.91
.80	30000.	0.0	10448.2	5872.6	6359.5	8121	1.7792	.4623	3.125	2946.65
.80	30000.	0.0	9812.5	5571.5	5971.0	8204	1.6710	.4386	3.125	2728.09
.80	30000.	0.0	8730.8	5026.6	5301.7	8319	1.4868	.3957	3.125	2417.58
.80	30000.	0.0	7622.9	4447.9	4609.3	8431	1.2981	.3502	3.125	2122.59
.80	30000.	0.0	6531.8	3853.4	3917.6	8524	1.1123	.3034	3.125	1842.21
.80	30000.	0.0	5494.5	3255.5	3242.1	8561	.9357	.2563	3.125	1582.77
.80	30000.	0.0	4522.6	2666.4	2595.0	8518	.7702	.2099	3.125	1346.40
.80	30000.	0.0	3628.9	2100.3	1986.6	8363	.6180	.1653	3.125	1132.33
.80	30000.	0.0	2813.6	1558.3	1419.9	8002	.4791	.1227	3.125	938.86
.85	30000.	0.0	11487.7	6054.7	6635.2	8091	1.9563	.4767	3.321	3264.72

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•85	30000.	0.0	10926.6	5804.3	6299.9	•8155	1.8607	•4569	3.321	3053.38
•85	30000.	0.0	10176.3	5454.1	5844.7	•8228	1.7330	•4294	3.321	2803.33
•85	30000.	0.0	8952.8	4868.5	5116.7	•8348	1.5246	•3833	3.321	2458.39
•85	30000.	0.0	7856.1	4324.9	4460.6	•8451	1.3378	•3405	3.321	2165.64
•85	30000.	0.0	6721.9	3724.0	3758.9	•8505	1.1447	•2932	3.321	1875.62
•85	30000.	0.0	5673.1	3140.8	3096.8	•8499	•9661	•2473	3.321	1613.03
•85	30000.	0.0	4663.4	2560.5	2459.8	•8429	•7942	•2016	3.321	1369.15
•85	30000.	0.0	3742.1	2004.5	1865.1	•8224	•6372	•1578	3.321	1150.27
•85	30000.	0.0	2919.0	1494.5	1330.9	•7660	•4971	•1177	3.321	956.17
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•65	36089.	0.0	7424.9	5086.3	5534.4	•7828	1.5910	•5039	2.472	2221.79
•65	36089.	0.0	7094.5	4906.4	5309.7	•7903	1.5202	•4860	2.472	2092.69
•65	36089.	0.0	6747.6	4715.7	5072.4	•7986	1.4459	•4671	2.472	1963.42
•65	36089.	0.0	6359.0	4492.8	4803.2	•8073	1.3626	•4451	2.472	1827.90
•65	36089.	0.0	5825.3	4177.5	4426.6	•8195	1.2483	•4138	2.472	1670.05
•65	36089.	0.0	5021.2	3676.8	3840.9	•8367	1.0760	•3642	2.472	1458.19
•65	36089.	0.0	4260.8	3177.4	3275.4	•8521	•9130	•3148	2.472	1263.61
•65	36089.	0.0	3495.2	2644.5	2684.2	•8646	•7490	•2620	2.472	1074.17
•65	36089.	0.0	2791.1	2120.1	2118.5	•8680	•5981	•2100	2.472	905.67
•75	36089.	0.0	8098.7	4944.5	5381.0	•8001	1.7354	•4868	2.852	2380.29
•75	36089.	0.0	7740.3	4739.0	5151.1	•8072	1.6586	•4694	2.852	2239.22
•75	36089.	0.0	7359.6	4544.3	4902.5	•8141	1.5770	•4502	2.852	2097.00
•75	36089.	0.0	6901.4	4304.6	4605.9	•8224	1.4789	•4264	2.852	1942.08
•75	36089.	0.0	6170.0	3905.6	4123.7	•8346	1.3221	•3869	2.852	1738.05
•75	36089.	0.0	5327.0	3425.8	3556.4	•8479	1.1415	•3394	2.852	1516.80
•75	36089.	0.0	4495.7	2928.5	2984.8	•8589	•9634	•2901	2.852	1305.19

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•75	36089.	0.0	3711.2	2431.1	2432.0	•8637	•7952	•2408	2•852	1112•44
•75	36089.	0.0	2982.2	1943.2	1902.7	•8591	•6390	•1925	2•852	936.52
•80	36089.	0.0	8478.5	4849.5	5329.4	•8044	1•8168	•4804	3•042	2469.93
•80	36089.	0.0	8098.7	4669.8	5092.6	•8109	1•7354	•4626	3•042	2320.91
•80	36089.	0.0	7698.8	4477.4	4840.6	•8179	1•6497	•4435	3•042	2171.96
•80	36089.	0.0	7182.3	4213.4	4508.8	•8250	1•5390	•4174	3•042	2000.20
•80	36089.	0.0	6322.0	3764.4	3963.0	•8374	1•3547	•3729	3•042	1766.42
•80	36089.	0.0	5492.5	3314.0	3427.9	•8486	1•1770	•3283	3•042	1548.31
•80	36089.	0.0	4624.3	2817.2	2853.9	•8568	•9909	•2791	3•042	1328.26
•80	36089.	0.0	3828.4	2330.8	2311.9	•8563	•8204	•2309	3•042	1132.68
•80	36089.	0.0	3068.0	1847.1	1787.5	•8467	•6574	•1830	3•042	952.40
•80	36089.	0.0	2393.8	1398.0	1308.8	•8214	•5129	•1385	3•042	790.43
•85	36089.	0.0	8884.2	4812.9	5312.3	•8095	1•9037	•4768	3•232	2567.09
•85	36089.	0.0	8492.4	4629.0	5063.2	•8145	1•8198	•4586	3•232	2411.29
•85	36089.	0.0	8061.1	4425.3	4795.1	•8203	1•7273	•4384	3•232	2252.00
•85	36089.	0.0	7456.7	4134.6	4423.8	•8286	1•5978	•4096	3•232	2057.13
•85	36089.	0.0	6513.3	3664.4	3847.5	•8407	1•3957	•3630	3•232	1804.07
•85	36089.	0.0	5655.8	3211.7	3307.1	•8486	1•2119	•3182	3•232	1578.19
•85	36089.	0.0	4767.0	2720.0	2736.5	•8526	1•0215	•2694	3•232	1353.62
•85	36089.	0.0	3952.1	2250.0	2210.0	•8507	•8469	•2229	3•232	1153.84
•85	36089.	0.0	3186.0	1787.7	1706.8	•8385	•6827	•1771	3•232	970.68
•85	36089.	0.0	2483.5	1338.1	1229.4	•8051	•5322	•1326	3•232	805.45
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•80	40000.	0.0	6892.0	3957.0	4339.6	•8672	1•7800	•4725	3•041	2022.70

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
• 80	40000.	0.0	6571.6	3805.4	4141.5	• 8142	1.6973	• 4544	3.041	1899.30
• 80	40000.	0.0	6224.1	3632.2	3918.5	• 8205	1.6075	• 4337	3.041	1772.55
• 80	40000.	0.0	5717.8	3373.2	3597.1	• 8295	1.4767	• 4028	3.041	1613.48
• 80	40000.	0.0	4954.6	2967.5	3107.5	• 8421	1.2796	• 3543	3.041	1408.88
• 80	40000.	0.0	4264.1	2583.3	2654.9	• 8518	1.1013	• 3084	3.041	1227.98
• 80	40000.	0.0	3553.2	2166.5	2179.6	• 8573	0.9177	• 2587	3.041	1049.07
• 80	40000.	0.0	2896.4	1760.2	1732.0	• 8545	• 7481	• 2102	3.041	888.57
• 80	40000.	0.0	2284.3	1361.4	1303.0	• 8379	• 5900	• 1625	3.041	741.67
• 80	40000.	0.0	1734.5	984.8	906.4	• 7983	• 4480	• 1176	3.041	610.47
• 85	40000.	0.0	7225.8	3926.4	4324.7	• 8117	1.8662	• 4688	3.231	2102.62
• 85	40000.	0.0	6896.3	3770.8	4115.3	• 8168	1.7811	• 4502	3.231	1972.97
• 85	40000.	0.0	6515.4	3590.8	3880.4	• 8233	1.6827	• 4287	3.231	1836.16
• 85	40000.	0.0	5909.8	3293.2	3505.3	• 8325	1.5263	• 3932	3.231	1651.40
• 85	40000.	0.0	5120.7	2892.4	3020.3	• 8438	1.3225	• 3453	3.231	1441.40
• 85	40000.	0.0	4396.5	2507.5	2562.5	• 8520	1.1355	• 2994	3.231	1252.10
• 85	40000.	0.0	3670.4	2095.8	2092.7	• 8530	• 9480	• 2502	3.231	1069.91
• 85	40000.	0.0	2996.8	1697.3	1652.5	• 8461	• 7740	• 2027	3.231	905.97
• 85	40000.	0.0	2369.8	1310.2	1235.7	• 8260	• 6120	• 1564	3.231	756.24
• 85	40000.	0.0	1806.0	946.3	853.2	• 7827	• 4664	• 1130	3.231	622.78
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
• 80	45000.	0.0	5243.3	3028.8	3312.2	• 8122	1.7204	• 4594	3.041	1559.46
• 80	45000.	0.0	4989.4	2905.2	3150.9	• 8167	1.6371	• 4407	3.041	1461.79
• 80	45000.	0.0	4662.8	2738.2	2939.4	• 8256	1.5299	• 4153	3.041	1350.50
• 80	45000.	0.0	4094.4	2440.6	2577.8	• 8381	1.3434	• 3702	3.041	1187.65
• 80	45000.	0.0	3548.2	2142.9	2223.5	• 8491	1.1642	• 3250	3.041	1040.33
• 80	45000.	0.0	2959.4	1804.4	1834.1	• 8573	• 9710	• 2737	3.041	889.98

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•80	45000.	0.0	2427.3	1477.7	1469.7	•8559	•7964	•2241	3.041	756.66
•80	45000.	0.0	1916.4	1149.4	1113.6	•6432	•6288	•1743	3.041	632.27
•80	45000.	0.0	1449.6	834.0	779.4	•8089	•4756	•1265	3.041	519.81
•80	45000.	0.0	1058.8	561.3	495.7	•7454	•3474	•0851	3.041	424.13
ERROR, CP OUT OF RANGE OF TABLE				0.0	-71.1	0.0000	•2449	0.0000	3.041	344.96
•80	45000.	0.0	746.2							
•85	45000.	0.0	5506.7	3005.1	3299.2	•8152	1.8068	•4558	3.231	1621.57
•85	45000.	0.0	5232.7	2875.7	3128.3	•8210	1.7169	•4362	3.231	1517.44
•85	45000.	0.0	4856.7	2694.4	2894.0	•8286	1.5935	•4087	3.231	1392.12
•85	45000.	0.0	4238.2	2386.0	2514.5	•8410	1.3906	•3619	3.231	1216.15
•85	45000.	0.0	3668.6	2084.8	2155.3	•8489	1.2037	•3162	3.231	1063.57
•85	45000.	0.0	3067.8	1751.2	1769.6	•8527	1.0066	•2656	3.231	910.54
•85	45000.	0.0	2519.1	1432.8	1412.0	•8496	•8266	•2173	3.231	773.06
•85	45000.	0.0	1993.8	1114.3	1066.7	•8349	•6542	•1690	3.231	646.06
•85	45000.	0.0	1518.5	807.5	741.0	•7943	•4983	•1225	3.231	532.19
ERROR, CP OUT OF RANGE OF TABLE				0.0	-76.5	0.0000	•3672	0.0000	3.231	435.31
•85	45000.	0.0	1119.0							
ERROR, CP OUT OF RANGE OF TABLE				0.0	-81.3	0.0000	•2620	0.0000	3.231	354.93
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•65	30000.	18.0	9892.6	6415.8	6981.0	•7778	1.7583	•5272	2.594	2970.49
•65	30000.	18.0	9455.4	6191.0	6699.8	•7853	1.6806	•5087	2.594	2798.67
•65	30000.	18.0	9002.9	5958.2	6405.3	•7937	1.6001	•4896	2.594	2625.57
•65	30000.	18.0	8467.4	5670.1	6051.8	•8031	1.5050	•4659	2.594	2439.57
•65	30000.	18.0	7567.7	5166.7	5449.0	•8188	1.3450	•4245	2.594	2175.51
•65	30000.	18.0	6571.6	4576.9	4760.0	•8353	1.1680	•3761	2.594	1906.63

XH	ALT	DELT	SHP	T	T+FKES	ETAP	CP	CT	J	WFT
•65	30000.	18.0	5596.2	3968.8	4072.1	•8506	•9946	•3261	2•594	1635•42
•65	30000.	18.0	4673.5	3361.2	3398.1	•8626	•8306	•2762	2•594	1422•05
•65	30000.	18.0	3811.5	2758.5	2744.8	•8680	•6774	•2267	2•594	1208•50
•65	30000.	18.0	3015.2	2166.6	2115.1	•8618	•5359	•1780	2•594	1014•02
•75	30000.	18.0	10771.9	6186.4	6768.3	•7947	1•9146	•5083	2•993	3177•09
•75	30000.	18.0	10292.9	5968.7	6483.7	•8025	1•8294	•4904	2•993	2988•61
•75	30000.	18.0	9779.7	5719.9	6162.6	•8094	1•7382	•4700	2•993	2796•34
•75	30000.	18.0	9065.3	5372.9	5726.0	•8202	1•6112	•4415	2•993	2563•58
•75	30000.	18.0	7949.9	4792.3	5022.6	•8342	1•4130	•3938	2•993	2246•35
•75	30000.	18.0	6938.7	4241.4	4375.9	•8459	1•2333	•3485	2•993	1974•87
•75	30000.	18.0	5893.2	3645.4	3695.0	•8560	1•0474	•2995	2•993	1707•80
•75	30000.	18.0	4949.6	3078.9	3063.7	•8608	•8797	•2530	2•993	1470•11
•75	30000.	18.0	4038.4	2503.8	2440.5	•8580	•7178	•2057	2•993	1247•07
•75	30000.	18.0	3210.3	1952.1	1853.0	•8415	•5706	•1604	2•993	1046•70
•80	30000.	18.0	11266.1	6099.7	6696.0	•7992	2•0024	•5012	3•193	3293•62
•80	30000.	18.0	10767.3	5884.1	6405.6	•8067	1•9137	•4835	3•193	3096•24
•80	30000.	18.0	10205.1	5621.4	6064.1	•8131	1•8138	•4619	3•193	2889•26
•80	30000.	18.0	9339.7	5211.0	5544.8	•8236	1•6600	•4282	3•193	2618•59
•80	30000.	18.0	8174.9	4628.5	4836.6	•8357	1•4530	•3803	3•193	2288•75
•80	30000.	18.0	7136.1	4087.6	4193.7	•8454	1•2683	•3358	3•193	2010•76
•80	30000.	18.0	6078.9	3511.6	3532.2	•8527	1•0804	•2885	3•193	1740•75
•80	30000.	18.0	5105.1	2955.2	2912.2	•8545	•9074	•2428	3•193	1496•86
•80	30000.	18.0	4170.7	2390.1	2299.0	•8459	•7413	•1964	3•193	1269•07
•80	30000.	18.0	3322.1	1855.2	1730.2	•8243	•5905	•1524	3•193	1065•06
•85	30000.	18.0	11794.8	6034.4	6650.3	•8024	2•0964	•4958	3•393	3419•26

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.85	30000.	18.0	11268.0	5808.5	6341.9	.8085	2.0027	.4773	3.393	3210.53
.85	30000.	18.0	10637.9	5535.1	5978.1	.8161	1.8907	.4548	3.393	2983.47
.85	30000.	18.0	9589.3	5050.3	5360.8	.8260	1.7044	.4150	3.393	2666.98
.85	30000.	18.0	8423.0	4497.0	4682.4	.8373	1.4971	.3695	3.393	2334.92
.85	30000.	18.0	7333.3	3956.9	4036.2	.8462	1.3034	.3251	3.393	2045.85
.85	30000.	18.0	6253.4	3384.6	3378.6	.8489	1.1114	.2781	3.393	1770.70
.85	30000.	18.0	5260.3	2836.6	2765.0	.8457	.9349	.2331	3.393	1522.87
.85	30000.	18.0	4305.0	2290.3	2172.0	.8344	.7652	.1882	3.393	1291.13
.85	30000.	18.0	3438.2	1772.3	1621.7	.8084	.6111	.1456	3.393	1083.89
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.80	20000.	18.0	16543.8	8635.1	9371.3	.8017	2.0598	.4970	3.323	4734.38
.80	20000.	18.0	15517.1	6193.8	6795.4	.8111	1.9320	.4716	3.323	4379.02
.80	20000.	18.0	13866.1	7431.8	7842.0	.8232	1.7264	.4278	3.323	3890.70
.80	20000.	18.0	12287.1	6676.1	6921.1	.8346	1.5298	.3843	3.323	3436.69
.80	20000.	18.0	10725.6	5902.0	6008.7	.8452	1.3354	.3397	3.323	3005.60
.80	20000.	18.0	9221.4	5105.1	5098.2	.8503	1.1481	.2938	3.323	2618.24
.80	20000.	18.0	7824.6	4329.7	4235.5	.8499	.9742	.2492	3.323	2266.15
.80	20000.	18.0	6505.3	3575.9	3413.3	.8443	.8099	.2058	3.323	1939.28
.80	20000.	18.0	5279.5	2839.5	2632.7	.8261	.6573	.1634	3.323	1642.71
.80	20000.	18.0	4195.0	2168.0	1933.3	.7938	.5223	.1248	3.323	1380.34
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.80	25000.	18.0	13744.6	7300.9	7973.1	.8001	2.0371	.5002	3.258	3973.32
.80	25000.	18.0	13078.4	7013.9	7587.4	.8078	1.9384	.4806	3.258	3718.74
.80	25000.	18.0	12156.5	6590.3	7046.4	.8166	1.8017	.4516	3.258	3414.05
.80	25000.	18.0	10729.5	5910.4	6206.4	.8298	1.5902	.4050	3.258	3004.65
.80	25000.	18.0	9459.7	5281.2	5449.6	.8410	1.4020	.3619	3.258	2643.34

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•80	25000.	18.0	8147.2	4591.0	4648.4	•8488	1.2075	•3146	3.2558	2302.13
•80	25000.	18.0	6947.7	3930.3	3900.4	•6521	1.0297	•2693	3.2558	1997.30
•80	25000.	18.0	5799.8	3274.3	3179.8	•8504	•8596	•2243	3.2558	1712.34
•80	25000.	18.0	4724.4	2628.2	2485.1	•8380	•7002	•1801	3.2558	1450.98
•80	25000.	18.0	3757.1	2019.9	1845.7	•8098	•5569	•1384	3.2558	1218.19
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•80	30000.	18.0	11266.1	6099.7	6696.1	•7992	2.0024	•5012	3.193	3293.63
•80	30000.	18.0	10767.1	5884.1	6405.7	•8067	1.9137	•4835	3.193	3096.25
•80	30000.	18.0	10205.1	5621.4	6064.1	•8131	1.8138	•4619	3.193	2889.26
•80	30000.	18.0	9339.7	5211.0	5544.8	•8236	1.6600	•4282	3.193	2618.59
•80	30000.	18.0	8174.9	4628.5	4836.6	•8357	1.4530	•3803	3.193	2288.75
•80	30000.	18.0	7136.1	4087.0	4193.7	•6454	1.2683	•3358	3.193	2010.76
•80	30000.	18.0	6078.9	3511.6	3532.2	•8527	1.0804	•2885	3.193	1740.75
•80	30000.	18.0	5105.1	2955.2	2912.2	•8545	•9074	•2428	3.193	1496.86
•80	30000.	18.0	4170.7	2390.1	2299.0	•6459	•7413	•1964	3.193	1269.07
•80	30000.	18.0	3322.1	1855.2	1730.2	•8243	•5905	•1524	3.193	1065.06
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•80	36089.	18.0	8675.4	4819.5	5319.8	•7991	1.9447	•4995	3.112	2576.19
•80	36089.	18.0	8309.6	4653.5	5097.5	•6055	1.8627	•4822	3.112	2427.48
•80	36089.	18.0	7923.5	4470.6	4858.3	•8116	1.7762	•4633	3.112	2278.41
•80	36089.	18.0	7487.7	4264.2	4589.3	•8192	1.6785	•4419	3.112	2121.21
•80	36089.	18.0	6776.3	3906.5	4145.1	•8293	1.5190	•4048	3.112	1905.54
•80	36089.	18.0	5887.8	3444.7	3589.3	•8416	1.3199	•3570	3.112	1664.42
•80	36089.	18.0	5060.0	2996.1	3063.8	•8517	1.1343	•3105	3.112	1448.99
•80	36089.	18.0	4242.5	2525.5	2531.2	•8563	•9510	•2617	3.112	1243.28
•80	36089.	18.0	3489.4	2069.1	2027.2	•8530	•7822	•2144	3.112	1057.60

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.80	36089.	18.0	2776.5	1617.6	1542.6	.8380	.6224	.1676	3.112	886.28
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.80	40000.	18.0	7044.9	3932.4	4332.2	.8027	1.9035	.4912	3.111	2108.73
.80	40000.	18.0	6734.8	3786.1	4140.0	.8084	1.8197	.4729	3.111	1984.70
.80	40000.	18.0	6412.0	3633.2	3937.6	.8149	1.7325	.4538	3.111	1859.98
.80	40000.	18.0	5984.6	3425.6	3673.4	.8232	1.6170	.4279	3.111	1715.40
.80	40000.	18.0	5269.9	3062.6	3228.3	.8357	1.4239	.3825	3.111	1509.52
.80	40000.	18.0	4591.3	2701.6	2797.8	.8462	1.2405	.3375	3.111	1323.46
.80	40000.	18.0	3873.1	2300.4	2335.0	.8541	1.0465	.2873	3.111	1139.39
.80	40000.	18.0	3219.3	1915.6	1904.6	.8557	.8698	.2393	3.111	975.01
.80	40000.	18.0	2591.7	1527.8	1482.7	.8478	.7003	.1908	3.111	821.28
.80	40000.	18.0	2022.7	1158.3	1088.6	.8235	.5465	.1447	3.111	683.98
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.10	0.	18.0	20407.2	23791.7	25480.7	.2404	1.3474	.7262	.446	6298.79
.10	0.	18.0	17880.2	22750.0	24157.6	.2623	1.1806	.6944	.446	5573.26
.10	0.	18.0	15666.6	21798.3	22984.5	.2869	1.0344	.6654	.446	4938.87
.10	0.	18.0	13400.5	20513.9	21484.1	.3156	.8848	.6262	.446	4300.59
.10	0.	18.0	11343.4	19223.4	20007.0	.3494	.7490	.5868	.446	3744.83
.10	0.	18.0	9439.7	17679.6	18305.2	.3861	.6233	.5397	.446	3237.68
.10	0.	18.0	7650.0	15763.4	16245.1	.4248	.5051	.4812	.446	2763.76
.10	0.	18.0	6026.8	13568.4	13930.1	.4642	.3979	.4142	.446	2334.36
.10	0.	18.0	4668.9	11354.5	11619.7	.5014	.3083	.3466	.446	1965.21
.10	0.	18.0	3558.3	9256.4	9452.8	.5363	.2350	.2825	.446	1650.88
.20	0.	18.0	20690.8	21579.7	23058.0	.4301	1.3662	.6587	.892	6355.30

XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•20	0.	18.0	18159.4	20709.4	21912.2	•4702	1.1990	•6321	•892	5625.85
•20	0.	18.0	15871.1	19560.2	20555.6	•5082	1.0479	•5971	•892	4977.08
•20	0.	18.0	13573.5	18100.8	18891.7	.5499	•8962	.5525	•892	4330.91
•20	0.	18.0	11483.0	16444.0	17065.3	.5905	•7582	.5019	•892	3769.10
•20	0.	18.0	9547.5	14625.0	15099.3	.6316	•6304	.4464	•892	3254.67
•20	0.	18.0	7775.6	12668.8	13007.3	.6718	•5134	.3867	•892	2785.14
•20	0.	18.0	6120.8	10524.1	10762.1	.7090	•4041	.3212	•892	2350.90
•20	0.	18.0	4751.5	8514.0	8672.5	.7389	•3137	.2599	•892	1980.43
•20	0.	18.0	3635.0	6734.0	6831.1	.7639	.2400	.2056	•892	1665.33
•30	0.	18.0	21128.2	19778.7	21061.2	•5790	1.3951	•6037	1.338	6441.76
•30	0.	18.0	18533.9	18530.1	19547.8	•6184	1.0238	.5656	1.338	5697.84
•30	0.	18.0	16192.9	17135.4	17946.0	.6545	1.0692	.5230	1.338	5032.64
•30	0.	18.0	13878.7	15560.4	16176.0	.6935	•9164	.4750	1.338	4384.50
•30	0.	18.0	11736.3	13854.6	14314.4	•7302	•7749	.4229	1.338	3813.49
•30	0.	18.0	9762.3	11969.4	12292.1	.7584	.6446	.3654	1.338	3291.40
•30	0.	18.0	7944.9	10100.5	10307.1	.7863	.5246	.3083	1.338	2814.14
•30	0.	18.0	6278.0	8217.6	8333.5	.8096	•4145	.2508	1.338	2378.18
•30	0.	18.0	4892.1	6503.3	6554.1	.8222	.3230	.1985	1.338	2005.53
•30	0.	18.0	3762.2	5038.8	5037.3	.8284	.2484	.1538	1.338	1688.51
XM	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
•10	5000.	18.0	17925.7	20667.1	22189.9	•2337	1.3752	•7330	•439	5522.66
•10	5000.	18.0	16312.8	20001.9	21345.3	•2486	1.2515	•7094	•439	5023.52
•10	5000.	18.0	14186.9	19112.2	20228.8	•2731	1.0884	•6778	•439	4423.29
•10	5000.	18.0	12318.0	18153.0	19084.3	•2967	•9450	.6438	•439	3888.85
•10	5000.	18.0	10426.9	17010.0	17765.6	•3307	•7999	.6033	•439	3381.10
•10	5000.	18.0	8734.8	15769.4	16375.3	.3660	.6701	.5593	•439	2929.60

XW	ALT	DELT	SHP	T	T+FRES	ETAP	CP	CT	J	WFT
.10	5000.	18.0	7153.6	14260.7	14730.6	•4041	•5488	•5058	•439	2512.42
.10	5000.	18.0	5667.6	12413.6	12770.8	•4440	•4348	•4403	•439	2124.88
.10	5000.	18.0	4376.0	10435.5	10697.6	•4834	•3357	•3701	•439	1780.89
.10	5000.	18.0	3335.1	8559.2	8755.5	•5202	•2559	•3036	•439	1492.22
•20	5000.	18.0	18265.7	18753.3	20111.4	•4163	1.4013	•6651	•877	5595.57
•20	5000.	18.0	16503.6	18215.2	19386.4	•4475	1.2661	•6460	•877	5060.43
•20	5000.	18.0	14383.0	17284.2	18237.3	•4872	1.1034	•6130	•877	4460.18
•20	5000.	18.0	12477.7	16186.2	16960.3	•5259	•9572	•5741	•877	3917.22
•20	5000.	18.0	10564.5	14819.6	15430.9	•5687	•8105	•5256	•877	3405.62
•20	5000.	18.0	8857.2	13344.1	13817.1	•6108	•6795	•4733	•877	2951.40
•20	5000.	18.0	7252.6	11641.3	11990.3	•6508	•5564	•4129	•877	2529.65
•20	5000.	18.0	5757.2	9777.2	10021.0	•6885	•4417	•3468	•877	2139.72
•20	5000.	18.0	4449.6	7940.9	8107.3	•7236	•3414	•2816	•877	1794.11
•20	5000.	18.0	3405.3	6341.6	6449.3	•7550	•2612	•2249	•877	1505.16
•30	5000.	18.0	18811.8	17386.9	18596.6	•5621	1.4432	•6166	1.316	5711.09
•30	5000.	18.0	16835.3	16485.4	17483.1	•5955	1.2916	•5847	1.316	5121.91
•30	5000.	18.0	14705.9	15330.9	16129.4	•6340	1.1282	•5437	1.316	4520.72
•30	5000.	18.0	12734.2	14094.3	14717.4	•6731	•9769	•4999	1.316	3961.41
•30	5000.	18.0	10789.8	12587.2	13058.6	•7095	•8278	•4464	1.316	3445.34
•30	5000.	18.0	9052.0	11056.2	11396.5	•7428	•6944	•3921	1.316	2984.90
•30	5000.	18.0	7414.2	9441.4	9672.3	•7744	•5688	•3348	1.316	2557.32
•30	5000.	18.0	5895.5	7726.8	7864.9	•7971	•4523	•2740	1.316	2163.95
•30	5000.	18.0	4574.2	6152.6	6225.1	•8180	•3509	•2182	1.316	1816.30
•30	5000.	18.0	3517.2	4773.4	4796.3	•8254	•2698	•1693	1.316	1526.06

Table I. - Propeller Design Information

DESIGN

Mach Number	= 0.80
Altitude	= 11,000 km (36,089 ft.)
P	= 5.740 Mw (7698.8 hp)
Propeller Net Thrust	= 19.6 kN (4414 lbf)
Residual Thrust	= 1.615 kN (363 lbf)
Total Net Thrust	= 21.25 kN (4777.6 lbf)
P/D^2	= 35.03
η_p	= 0.817
J	= 3.081
C_p	= 1.692
C_T	= 0.4485
W_f	= 984.98 kg/hr (2171.96 lbm/hr)
TSFC	= 0.046 kg/hr/N (0.455 lbm/hr/lbf)
η_{ov}	= 0.434
T/P	= 3.705 N/kw (0.621 lbf/hp)
Propeller Diameter	= 4.519 m (14.825 ft.)
Number of Blades	= 8

SLS/MAX THRUST

P	= 14.0 Mw (18,780 hp); maximum available = 15.23 Mw (20,424 hp)
Net Thrust	= 88.79 kN (19,961 lbf)
C_p	= 0.8565
C_T	= 0.5540
J	= 0.0
W_f	= 1.940 Mg/hr (4277.9 lbm/hr)
T/P	= 6.342 N/kw (1.063 lbf/hp)
TSFC	= 0.022 kg/hr/N (0.214 lbm/hr/lbf)
P/D^2	= 490.1 kw/m ² (61.067 hp/ft ²)

Note: Maximum sea-level-static (SLS) thrust does not occur at maximum engine horsepower because of propeller blade stall.

Table II. Comparison of Selected Engine Parameters

<u>Engine Type</u>	<u>Engine Thrust - Weight Ratio</u>		TSFC	η_{ov}
	<u>Sea Level Static</u>	<u>Sea Level</u>		
(1) Turboprop (Propfan)	3.41	3.71	1.14	.456
(2) Pratt and Whitney JT9D-25 Turbofan	5.50	4.22	1.43	.631
(3) Pratt and Whitney STF-477 Turbofan	6.74	4.89	1.88	.575
				.339

Note: All engines are sized to produce net thrust equal to that of the JT9D-25 at $M = 0.8$,
9144 m altitude.

**THRUST SFC
VERSUS
UNINSTALLED NET THRUST
STANDARD DAY**

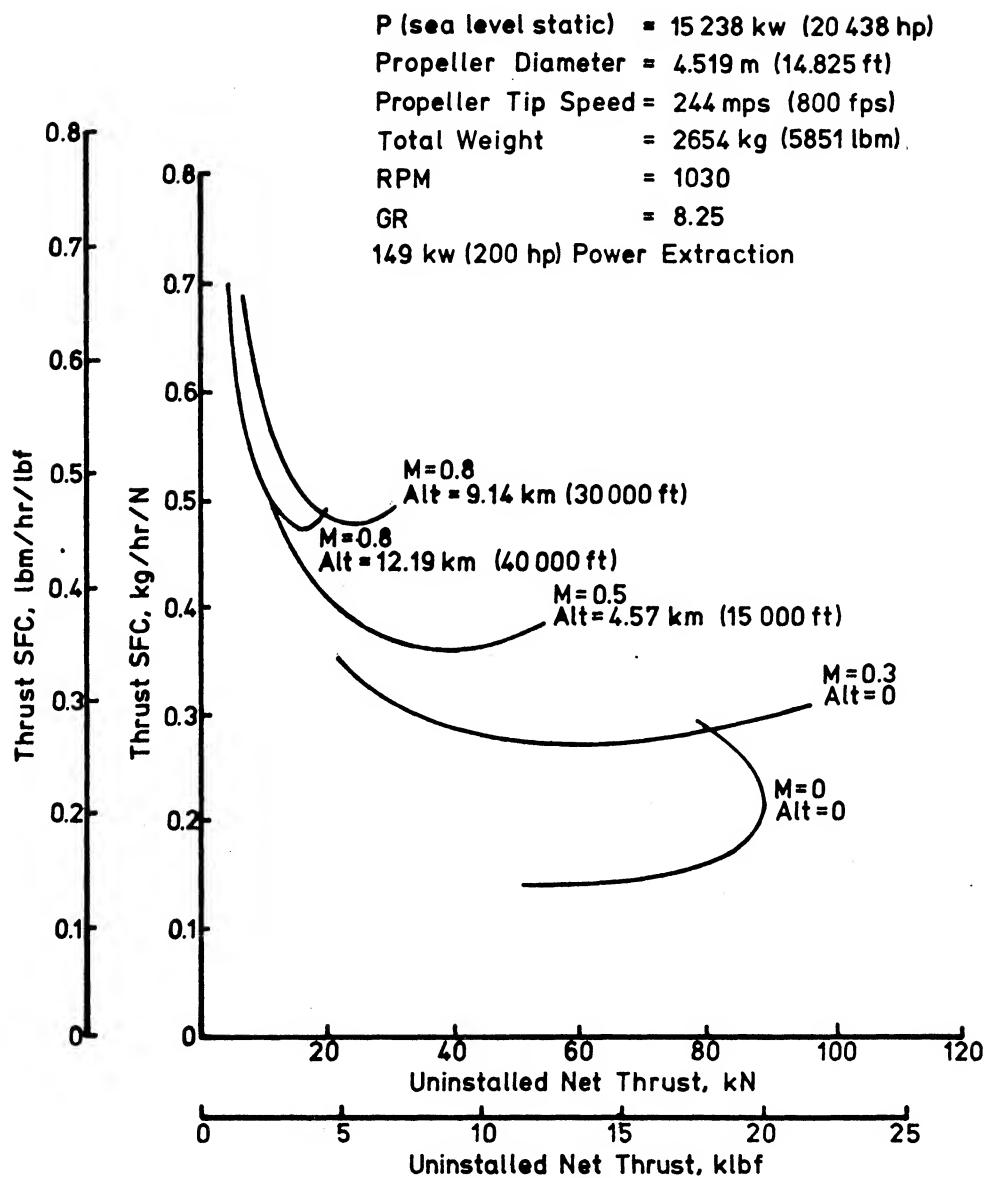


Figure 1. - Propfan performance.

THRUST SFC
VERSUS
UNINSTALLED NET THRUST
STANDARD DAY

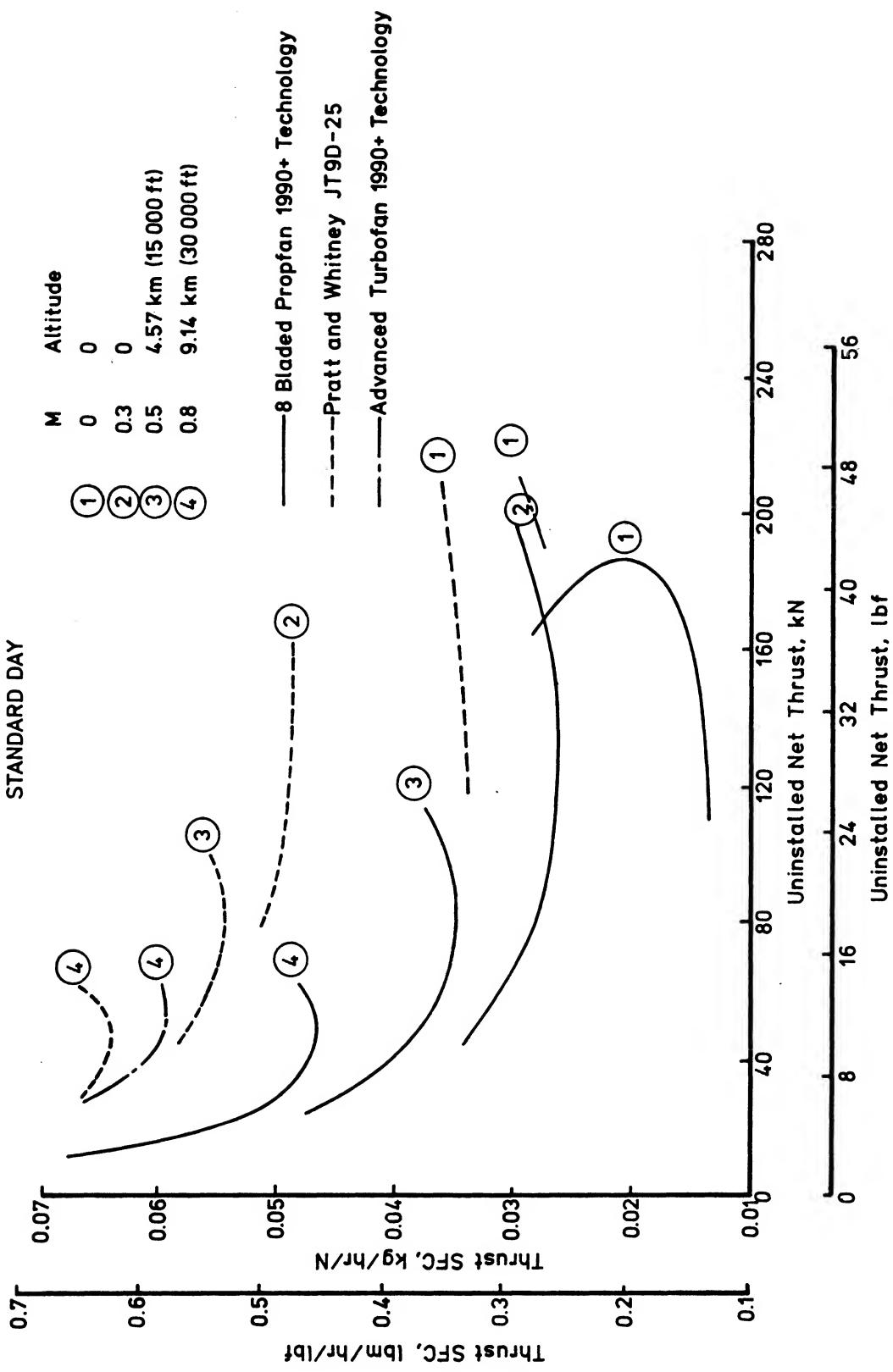
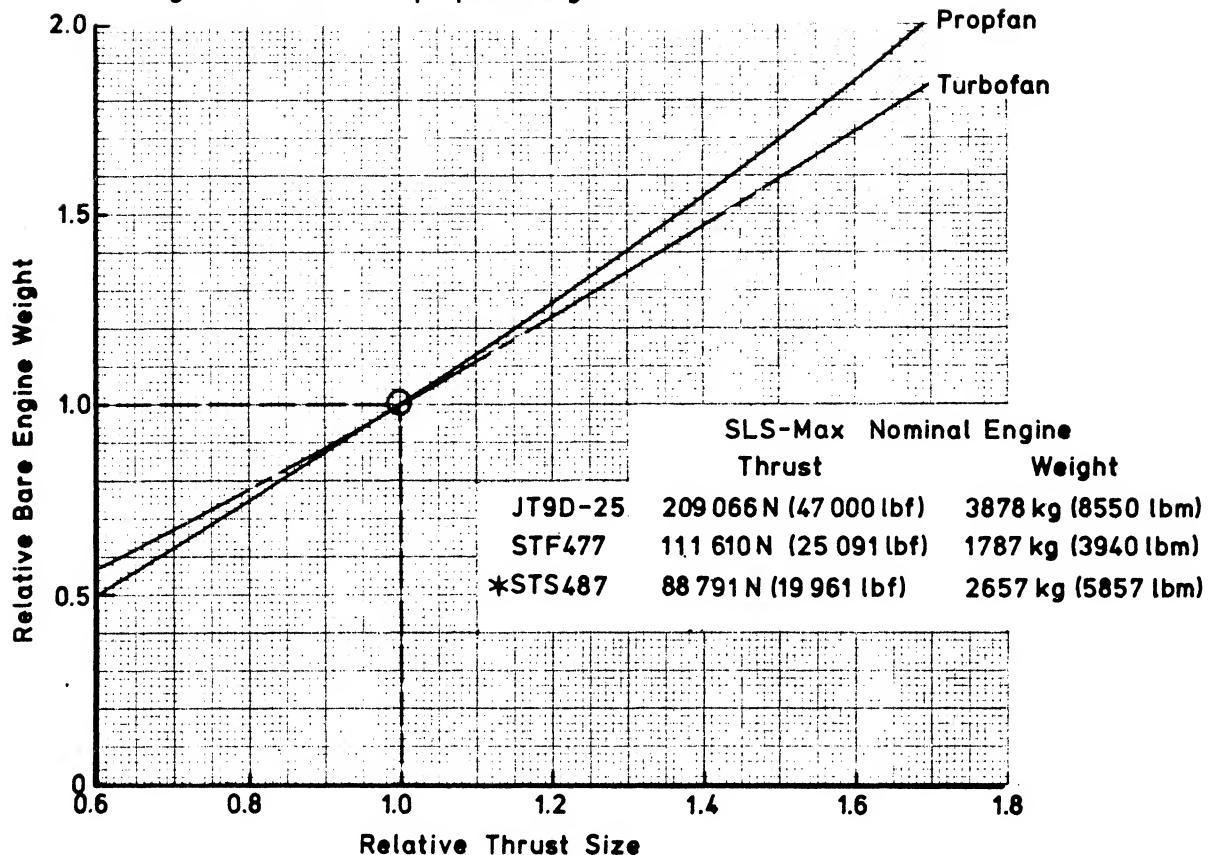


Figure 2. - Performance comparison

Multiply propfan weight by 1.3 to
get installed total propfan weight.



*Maximum thrust SLS not at maximum power because of propeller stall.

Figure 3. - Weight scaling for bare engine.

1. Report No. TM-80075	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Performance Estimation for a Highly Loaded Eight-Blade Propeller Combined With an Advanced Technology Turboshaft Engine		5. Report Date April 1979	
7. Author(s) Shelby J. Morris, Jr.		6. Performing Organization Code	
9. Performing Organization Name and Address NASA Langley Research Center Hampton, Virginia 23665		8. Performing Organization Report No.	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546		10. Work Unit No. 516-50-23-01	
		11. Contract or Grant No.	
		13. Type of Report and Period Covered Technical Memorandum	
		14. Sponsoring Agency Code	
15. Supplementary Notes Pratt and Whitney representatives have reviewed the data in this report and have indicated that this data is neither classified nor proprietary.			
16. Abstract Performance estimation, weights, and scaling laws for an eight-blade highly loaded propeller combined with an advanced turboshaft engine are presented. The data are useful for planned aircraft mission studies using the turboprop propulsion system. Comparisons are made between the performance of the 1990+ technology turboprop propulsion system and the performance of both a current technology turbofan and an 1990+ technology turbofan.			
17. Key Words (Suggested by Author(s)) Propfan Air Breathing Propulsion Propeller Turboshaft		18. Distribution Statement UNCLASSIFIED - UNLIMITED Star Category 07 - Aircraft Propulsion and Power	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 47	22. Price* \$4.50